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SCHOOL SCIENCE AND MATHEMATICS

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"It is the firm duty of each of our free citizens and of every free citizen everywhere to place the cause of his country before the comfort of himself.

" . . . We shall never try to placate an aggressor by the false and wicked bargain of trading honor for security."

From the Inaugural Address of DWIGHT D. EISENHOWER

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SCHOOL SCIENCE AND MATHEMATICS

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ARITHMETIC IN THE UPPER ELEMENTARY

CORA C. CHRISTIAN
Sycamore, Illinois

Arithmetic is systematic, logical thinking. One of the greatest fallacies of the elementary curriculum is to classify arithmetic as a skill, or a drill, or a tool subject, the importance of which is the shaping of the tool and no the use of it. When it is viewed in these terms and is taught accordingly, the results are just what we have been getting for the last several decades—arithmetical incompetence.

Arithmetic is not a tool or a drill process. Of course, speed and accuracy are necessary, but more than proficiency is demanded by the complexities of twentieth-century civilization. We must be able to think and one does not think effectively with mechanical skills alone. One must understand what he is doing when he uses the mechanical skill. Authors of arithmetic books have recognized this importance and are now placing more emphasis on meaning. Mechanical proficiency now follows understanding. Formerly, emphasis was placed on process and drill.

Current practice in teaching arithmetic arbitrarily divides the subject into two parts—fundamentals and problem-solving. Skill in reading and solving problems, and choosing the correct process is far more important than skill in fundamentals. We do not mean to say that a thorough knowledge of the fundamental processes is not essential to the final step in problem solving, but it is true that if we did not need to solve problems we should have no practical use for the facts and fundamentals.

In the past, standardized tests indicated that pupils were weaker in problem-solving—not in fundamentals.

Why is problem-solving difficult for pupils?

1. Arithmetic possesses a special vocabulary which is not acquired in ordinary reading. It must be gained through use in a number of experiences.
2. Leisure-time reading calls for a different set of habits from the study type needed in problem-solving. Instead of rapid skimming, careful examination is required and it is often necessary to read a problem more than once in order to get the meaning. In lesiure-time reading one may skim and still get the meaning, while in problem-solving one cannot skim, for many times, it is the little words, such as "more" or "less," that are important.
3. It is believed that wrong attitudes may be another reason for difficulty in problem-solving. One pupil says he never liked mathematics—never could do it. Another says his family were all poor in mathematics, so he should not be expected to do well in that subject. Another says that if the answer is correct, what difference does it make what method is used.

Problem-solving procedures are basic to all problem-solving.

A method for solving problems which is basic to all problem-solving whether in the text-book or in real life is as follows:

1. Visualize the problem-situation. This does not mean to choose the process necessary for finding the answer. It means to size up the problem using any concrete material necessary.
2. Reflect upon the size of the answer in comparison with the data given in the problem. The pupil can ask himself, "Is the answer going to be larger or smaller than the base?"
3. Decide what processes to use—whether to add to the number, subtract from it, multiply it, or divide.
4. After the pupil has done his best to visualize the problem-situation, reflect on the size of the answer and decides which process to use, he is ready to compute. This is the only place where computation has any real significance.
5. Test the answer. The pupils asks, "Is my answer reasonable?" He should be able to form some specific question or questions to help him find out. He might ask himself, "Does a bicycle ever cost $395?" The absurdity makes him realize that he has made an error.

Developments must be provided that aim directly at showing the pupil how he can use his commonsense to test his work.

These five points, valuable as they may be, are worth little unless they are applied by the pupil.

HANSON STATE GEOLOGIST FOR WISCONSIN

The University of Wisconsin regents Saturday approved the selection of George F. Hanson for the post of Wisconsin State Geologist and instructor in the UW department of geology.

A native of New Hampshire, Hanson received his early education in British secondary schools and attended Oxford University for a year, 1934–35. He returned to the U. S. permanently in 1938 and was granted his bachelor's degree from Union College, Schenectady, in 1943, and his master's from the University of Wisconsin in 1952.

His teaching experience includes an undergraduate assistantship in geology and a year's instructorship at Union College, He is the author of several technical monographs in the field of geology. He served with the Merchant Marine during World War II.

Ernest F. Bean, former state geologist who retired recently, will continue to serve in an advisory capacity in the state geologist's office.

OUR VIRGIN PLANET

AARON GOFF
Central Commercial and Technical High School, Newark, N. J.

Although two billion people or more are today contributing to the exploitation of the earth's resources, they are still not much worse than two billion ants let loose in an Amazonian jungle. The tremendous resources of the earth are certainly showing signs of wear and tear, but the gloom which permeates the writings of certain prophets, is based on the premise of an unchanging civilization. True, if we depend on the same foods, on the same agricultural techniques, on the same materials, on the same minerals and the same sources, we are doomed to eventual starvation, overcrowding and possible self-elimination. We, however, need not and will not adhere to current practices for all time to come. We can improve our techniques, find new sources, use substitutes and develop novel and perhaps hitherto unheard of means of meeting shortages. Let us examine the food problem merely for trends which have already crossed the horizon and are in use.

The problem of soil erosion not only can be but is being overcome by the Department of Agriculture in its efforts to educate the farmers in the techniques of contour plowing, windbreaks, irrigation, cover crops and rotation. The rapid availability of Krilium and the present rush to market similar polyelectrolyte resins as soil conditioners augurs well for quick soil reclamation where erosion has exposed clay type subsoil. The fact that one pound of these resins is equivalent in action to 200 lbs. of peat moss or 500 pounds of compost, places this one step in the class of modern scientific miracles.

Reports have been published of the use of new methods of cultivation, fertilizing and irrigation which in combination give yields of crops far in excess of the expected aggregation of individual improvements. Add to this the fact that the large majority of the world's farmers are far behind the United States farmer in efficiency. Just recently a Senate subcommittee on Labor and Public Welfare published a report on "Manpower, Chemistry and Agriculture," which raised an alarm over possible unemployment on farms due to the mechanical and chemical revolution in agriculture.

When we consider the availability of unlimited nitrogen by fixation from the air, of phosphorus, calcium, potassium from minerals that can be mined, and the potentialities of sewer sludge, garbage, and ocean salts, there should be no fear of famine due to these shortages. Add the successful fight against insects by the newer insecticides, constant improvements in fungicides, weedicides, and rodenticides, and we can easily understand how the same growing effort of

our farmers can supply us with perhaps twice the amount of food which reaches the market at the present time. Think of the new types of fruits and vegetables which are resistant to disease, the hormone sprays to prevent dropping, the hybrid corn which has increased the yield per acre by as much as 25% in some places. Think of the use of trace elements in fertilizers, the feeding of antibiotics, A.P.F. and B 12, which mysteriously increase the weight of animals with less food. These are certainly not the signs of a decadent argicultural industry.

Aside from improvements in traditional agricultural practices, we may look forward to new departures. Fish farming, which has been very successful in India and China, may become a Point Four exchange item, with the United States as beneficiary. Reports have come in that as much as 4,000 pounds of fish can be raised per acre per year. There are always new crops too, which may be introduced to replace monoculture and provide more efficient use of the land. Not too long ago, soy beans and tung trees were considered exotic, and the chinese tallow tree, ***sapium sebiferm***, which yields a wax containing stearin and palmitin, is now being grown in the south. Several laboratories have reported encouraging results from the growth of algae under artificial control in ponds, which may serve as food for beef more efficiently even than grass. In fact, there is a great deal of evidence that certain yeast cultures are in some ways the most efficient manufacturers of protein from carbohydrates to be found in the world of living things. We must not forget that in some parts of Japan, seaweeds are semi-farmed in bays and are then used as food by man or his animals. Our own farmers, in years gone by, have harvested seaweed for use as fertilizer in their fields near the ocean.

The picture is not entirely dark if the results of scientific research are put to work in time. If hair, silk, quinine and steroids can be synthesized, all, by the way, through the work of Professor Robert Woodward of Harvard, and several collaborators, there is increasing hope for the eventual synthesis of proteins and carbohydrates. In Germany, fats have been synthesized by a process which starts with coal to yield acetylene and formaldehyde which are then converted to glycerol. Fatty acids are derived from the Fischer Tropsch treatment of coal with steam. The two are then combined to form edible fats. In the United States, the Forest Products Laboratory of the Department of Agriculture, has successfully worked out a modification of a German process to obtain sugar and alcohol from fir chips and sawdust. Other products of sawmill wastes include furfural (useful in making dyes, lacquers and plastics), fodder yeast food, and lignin, which is used for solvents, plastics and fuel.

Another branch of the Department of Agriculture has succeeded in making commercial quantities of butanol, acetone, wood alcohol and lignin from corncobs. The process of photosynthesis will undoubtedly be duplicated on a commercial scale sooner or later, and the mere thought is somewhat terrifying. The dislocation to thousands of farmers and laborers in this country, the West Indies, Hawaii and the Philippines, will become a major social and economic problem when it becomes possible to synthesize sugar in a few large factories employing perhaps a few hundred men to keep the valves, pumps and mixers, filters and crystallizers running. Just as coal tar dyes, synthetic fibers and synthetic rubber have played havoc with plantations and silk culture establishments, we must expect the chemical revolution to involve still further industrial metamorphoses on this good earth of ours. We shall either synthesize a large part of our food eventually, or be able to turn every kind of leaf or blade of grass into some edible form by chemical or microbiological means. In the long run, it means a more efficient utilization of carbon, hydrogen, oxygen, nitrogen, and perhaps twenty other elements of which there is no foreseeable lack. These twenty odd elements have to be arranged and rearranged on a mass basis so as to make our living possible on earth. Chemistry is rapidly approaching the stage where this can be managed with a minimum of backbreaking work in the old tradition.

Let us turn to the matter of sources of energy and their depletion. While petroleum seems to be definitely on the danger list, the discoveries, on a world wide basis, more than compensate for the rate of use. The coal and oil shale situations brighten the picture considerably. The treatment of shale and coal to produce fuel oils and gasoline is an industrial fact in Sweden, England and Germany. In this country the Bureau of Mines is meeting with great success in developing its own versions of the Bergius and the Fischer Tropsch coal conversion processes, and at Rifle, Colorado, the "kerogens" of oil shale are being treated to yield a large number of oils, solvents and possible fuels. Lest we forget, there is also the cheerful prospect of tremendous quantities of fuel, ethyl alcohol available from fermentation of saw dust extracts, potatoes, corn and any other carbohydrate crop grown. These are resources which will not run out. Cellulose can be found in most common plants, while starches and sugars have always been comparatively abundant at least in this country. Automobile carburetors can be adjusted to run on fuels containing as much as 15% alcohol, and perhaps more.

Estimates of coal reserves including bituminous and lignite run into thousands of years. We have here a practically limitless source of carbon and hydrocarbons which can be manipulated into all sorts

of fuels, perfumes, dyes, fertilizers and other organic necessities. The handling of coal is approaching its peak of efficiency in the experiments with coal gasification which have already met with some success in England and Russia. The underground burning of coal as a method of producing fuel gas and the usual byproducts of the coke oven will be a terrific labor saver which may lead to still another technological revolution of far reaching economic importance.

We can foresee too, the wider use of water power from waterfalls and dams to contribute to our supply of energy and to the conservation of our soil. Development of more Tennessee Valley Authorities and Columbia River projects will eventually supply a vastly greater proportion of our electrical current needs than we use at present. This is a type of exploitation which does not involve expendable materials but uses that almost infinite reservoir of the environment—the natural water cycle. The unpredictable has been witnessed in the expansion of the natural gas industry so that tremendous quantities are being pumped to New York from Texas and Oklahoma with the consequent reduction in the need for coal and oil for artificial fuel. Still in the formative stage are the ideas which involve the utilization of the sun, nuclear energy, the movements of the oceans, the winds and even the interior of the earth as sources of energy.

In the matter of solid materials which are used in the construction of cars, buildings, furniture and machinery, we can maintain the same optimistic point of view which has carried us through a survey of the food and fuel problems.

It is noteworthy to mention here that the use of forestry products has declined 1% in the period between 1900 and 1950, although the debit side of the ledger carries the sad fact that 90% of our original forests are gone. Of course, this is more than overshadowed by a 600% increase in the over-all use of minerals and fuels. In fact, since 1917, the United States has used more minerals than the total used before that year by all of mankind since the coming of civilization. Nevertheless, we need not despair. Aerial photography and airborne instruments, such as the electromagnetic surveyor and the scintillometer have already helped locate tremendous deposits of high grade iron ores in Laborador, Venezuela, and Brazil. The estimated five billion tons of taconite lying in the ground in Minnesota will some day be turned into almost a billion tons of steel if present pilot plant operations proceed according to plan. The tremendous expansion of the aluminum industry with unlimited resources if we include the clays of the earth, the spectacular rise of magnesium which is obtained by the thousands of tons from the sea, and the brilliant rise of titanium as an abundant structural metal second in strength only to steel, yet much lighter, will certainly take the pressure away from

the steel industry. Of course, a war economy and industry will destroy materials faster than they can be extracted, manufactured and discovered. A little sober thought reveals that this may be the limiting factor of the next war or may even prevent it. If a nation such as ours would have difficulty supplying itself with the materiel of war, perhaps there will be no war since no other nation can possibly match our own industrial potential.

While we have become the largest importers of lead and zinc and we do import large quantities of other metals and raw materials, in peacetime, this is no problem because of our ability to export great quantities of manufactured goods.

For the future, we can see trends and straws in the wind. The corrosion problem has been a constant headache, which has been solved in a variety of ways. Some of the newer techniques include electrolytic couplings, which sacrifice an inexpensive replaceable metal for the more vital iron in a steel pipe. Another method uses a low voltage D.C. whose negative charge prevents the solution of a metal by chemical agents. While the scrap collecting activities in this country are far from exhaustive, we shall witness an intensification of the efforts in the future to get every possible ounce of reclaimable metal back to the foundries. One expert has even suggested the possibility of leasing a car to an owner with the stipulation that it must be returned to the dealer at the end of its useful life. This would, at least, insure the automobile manufacturers of a constant supply of metals. We may see a trend toward smaller and less extravagantly furbished cars in the future, since there is a large amount of waste in weight and chromium finish in a car which may be used for short distances daily in getting to work or to town and back to the farm.

Finally, we must admit that the earth has only been scratched by mankind's long history of mining operations. Every evidence points toward the probability of finding much greater deposits of metal bearing ores,—at least, of the heavier metals, at greater depths than those presently worked. Here is an entire new world for some mining genius to conquer. Just as the air, and sea have no boundaries, so do the depths of the earth belong to all nations. The prizes await those who can develop the machinery and techniques, just as the wealth of the oceans awaits those who will bring to bear the proper chemical attack. The future of mankind in a material sense is assured by his intelligence and resourcefulness, but spiritually and morally, we can have no certainty of physical salvation until there are both universal peace and an atmosphere conducive to scientific progress directed solely toward human welfare.

How poor are they that have not patience!—Shakespeare.

CONSERVATION ACROSS THE UNITED STATES*

RAYMOND KIENHOLZ

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The growth of educational tours in recent years is one of the outstanding developments in the field of education. Nor are these tours limited to adults. Secondary and elementary schools are likewise sending their pupils on trips, short and long. The summer vacation season fairly bristles with cruises, tours, and hikes of all imaginable sorts. Youth agencies are taking this period of freedom from routine schools schedules to conduct trips of many kinds. Summer camps are more and more turning to hikes and trips to drive home the facts of nature and conservation.

For many years colleges and universities have conducted trips in geology and biology. These trips have increased in number, variety and length, and have been supplemented by many in other fields, notably social studies, history and economics. After some years of experience in teaching conservation in several workshops where field trips are an extremely important part of the work, it seemed to me worthwhile to organize an extensive conservation field trip. If a one-day field trip was a profitable experience for my students, perhaps a two-month tour would be many times as worthwhile. After months of thinking it over and consulting with my Conservation Workshop students, it seemed a more feasible venture than ever.

Sight seeing trips to the West or to foreign countries were not the kind of tours I was interested in. I wanted first of all a tour at a reasonable cost. In the second place, I wanted my students to live with the things they were going to study. This called for a sort of continuous camping out experience. Previous trips across the continent and many summers spent in field work in many parts of the U. S. indicated some of the things that should be included, and many that should be omitted. They likewise indicated the mode of living we should adopt on the trip.

I was somewhat acquainted with two types of trips which came closer to being the kind of tour I was interested in than any other. One was the type of trip frequently taken by Professor Lynds Jones of Oberlin College to the West Coast to study ornithology and ecology. I encountered one of those trips in the field north of Yellowstone National Park in 1927. The other type was the trips conducted by Professor Victor Shelford of the University of Illinois to various parts of the continent to study animal ecology. The apparent suc-

* Report of an illustrated lecture given at the Banquet meeting of the Central Association of Science and Mathematics Teachers at the Edgewater Beach Hotel, Chicago, November 28, 1952.

cess of these trips impressed me greatly. Why not organize a similar trip to study the conservation of our natural resources?

I first started advertising the trip outside of my Conservation Workshop by distributing descriptive folders at the American Association for the Advancement of Science Meetings in New York City, December, 1949. These folders were mailed to many individuals and organizations.

The tour was scheduled for the summer of 1951, and many people wondered whether I had made a mistake in designating 1951 as the time rather than 1950. I found, however, that the many problems that had to be solved required all of the time I had allowed, namely 1½ years. I point this out here as a warning to others organizing similar trips—allow yourself plenty of time. I know of several trips that have failed because inadequate time was allowed to organize the trip, and especially to advertise it far and wide, allowing ample time for those who might be interested to make up their minds. Likewise, many persons who are interested wish to lay their plans several summers ahead. That is, if they should wish to go on a tour in 1951, they may plan to take summer school work or earn money or shorten their vacation in 1950.

I wrote to many periodicals asking them to insert notices of the tour in their columns. I likewise sent folders to most of the Conservation Workshops in other states. This was the first such extensive conservation tour, and it was necessary to spread the news very widely. A second folder containing a pictorial sketch map of the tour route was printed in large numbers for further distribution.

In the meantime arrangements went forward regarding the tour organization. There were many matters that had to be decided, such as: the amount of the fees, when they were to be paid and to whom, accident insurance, health certificates, personal equipment and clothing, chartering a bus with all the details that needed to be cleared with the bus company and the University.

Requests for information regarding the tour came into my office. Some of these went no further than a request; others finally reached the stage of application for permission to be included. Then followed letters to those who knew the applicant, in order to assure me that the applicant was congenial, mature and somewhat experienced in outdoor living and travel. Acceptance of an applicant was followed by letters of instruction and advice.

In order to avoid the difficulty of part of the group getting lost, I early decided on a bus as the means of travel. As a result of my experience with several tours, I believe firmly that the advantage of all travelling as one group cannot be overemphasized. The bus was equipped with a loudspeaker enabling the leader to call the attention

of the group to interesting things seen along the way. This is a very valuable teaching device. By travelling as a single group, the travellers soon build up a strong esprit de corps as they kid back and forth, as they sing together, as they stop to examine some project or stop for a drink or lunch in the course of the day's run. By daily rotating the seating arrangement, everyone had a chance to sit with everyone else, thus getting better acquainted and breaking up any cliques that might otherwise build up.

On previous trips I had become acquainted with the delays caused by a large group trying to get fed at a small restaurant. Also, I knew of the poor food and the monotonous similarity of the menu that one encounters in the sparsely settled parts of our country—not to mention the high cost. But more important than all of these things was the fact that we planned to sleep out nights stopping at national parks and forests and similar places. These places were usually far removed from restaurants, and the extra time and travel involved in getting to and from an eating place seemed appallingly great—impossible in some cases. All of these factors indicated some sort of a mobile kitchen unit that could provide us with meals at the place where we stopped overnight.

To fill this need, I first purchased a small trailer. The idea was that a trailer, arriving at the evening camping place, could be unhooked and the evening meal started while the car used to pull the trailer would be free to shop for food or do other errands. Offsetting this, however, was the slowness of travel of the trailer and the added cost of a car to pull the trailer. I finally sold the trailer and purchased a ton pickup-body truck. This was modified in such a way as to form a plywood body 8 feet by 8 feet and 4 feet high. This body was covered by a tarpaulin supported on three ribs which could be raised while preparing the meal, so as to give head room for those working in the kitchen, and dropped and tightly fastened down while traveling. The "mess truck" was equipped with a six-burner stove using bottled gas supplied by four 20 pound tanks on the running board. No difficulty was encountered anywhere on the entire trip in purchasing additional gas. Small movable steps gave access to the body of the truck. An ice box was also constructed in which ice could be kept for as much as four days. The interior of the truck was fitted with shelves for working space and storage. It was also equipped with a sink for washing dishes. This last however, was never used on the trip as dish washing inside the mess truck proved too crowded. Five light, folding tables were built, and as soon as the mess truck arrived at its destination these were removed and set up in rows. They worked out satisfactorily for preparing and serving the meals, as well as for washing dishes after meals. A number of folding stools were

constructed and taken with us on the trip, but these could have been dispensed with. We usually sat on logs or on the grass or at picnic tables.

The advantages of having a mobile "chuck wagon" to accompany the trip cannot be overemphasized. In a trip of any length which penetrates sparsely settled or wild areas, the advantage of having meals available at the place of overnight stop is very great. In addition, the advantage in developing a strong feeling of comradeship among the members of the tour by eating together, working together in preparing and serving the meals, is incalculable. In organizing any similar trip, I feel that such an arrangement is absolutely essential. Even though we sometimes had to wait for the mess truck to arrive and prepare our supper, the entire group was together, while otherwise we would have been scattered in a number of restaurants trying to get fed. The construction of such a mess truck involves a considerable amount of work and some expense, but I am convinced that it is worthwhile. Based on the experience gained, I would suggest certain changes. In the first place, a ton truck is very rough riding and not as speedy as it should be. This frequently resulted in the mess truck being greatly delayed and the group having to wait long hours for their supper. A smaller, lighter, faster conveyance would be more desirable. In the second place, we took with us some unnecessary utensils, equipment and food. These took up a great deal of space and added to the weight of the truck.

To go back to the method of laying out the route of travel on such a tour. The more extensive the director's knowledge of the country to be traversed, the more intelligently he can lay out the preliminary route. First I decided California and the West Coast would be our goal, partly because of the many things to be seen in that remarkable region, and partly because of the psychological appeal of "California," "Pacific Ocean" and "West Coast."

At first I wrote general letters to the various states, addressing them to Conservation, Development, Forestry, Fish and Game or Highway Departments, asking them to list places of possible interest to a group studying conservation. Usually I got a reply to the effect that if I would designate more particularly the route I wished to travel, they would tell me what there was to see. I soon learned the better way was to indicate roughly the route to be followed and ask for suggestions along or near this route. By writing to many State Departments, Agricultural Colleges, to friends and acquaintances, to federal agencies, to Chambers of Commerce and similar regional agencies, I accumulated a large amount of material from which I could choose my route and the projects to be visited. It soon became a problem of choosing the most desirable projects along a certain

route of travel and within our limitations of time. In any trip, long or short, the time factor eventually becomes the limiting one.

After many letters and much picking and choosing of projects and rechecking certain points of information, the route of travel became more definite. The final step was to divide the route into daily runs. This was not always easy, the greatest difficulty being the length of time that should be allowed for the inspection of the projects to be visited, and the need for choosing an overnight stopping place. For this planning, good maps are essential. The best are those booklets containing maps of all the states. Three copies were purchased, one each for the bus driver, the driver of the mess truck and myself. Thus there was no question of the route due to different maps showing different roads.

It was always necessary to find a good place to stop overnight. Until we got out into the semi-arid parts of the West and until we became more experienced campers, I arranged our night stops so we could get under cover in case of rain. In addition, each tour member provided their own tentage. It was seldom needed, however.

A loose-leaf notebook served as an admirable lay-out device, each day's trip being given a page. The map mileage between towns was listed and the cumulative mileage noted, as well as points to be visited, the overnight stopping place, persons to meet, etc. On these sheets alternative routes could be listed and fresh information added as it was obtained. Choices could then be made and the final revision inserted and the old sheets discarded. This proved to be a flexible, usable method of great convenience. It served as the control book for the entire route. In addition, a file of the most essential letters of permission, letters of introduction and similar correspondence was carried with us in the bus.

With such a large group it is necessary to determine in advance each night's stopping place. Our stops included national and state parks and forests, experiment stations, forest ranger headquarters, college campuses, lumber companies and wildlife refuge headquarters. Only twice did we need to use private camp grounds. Everyone was most cordial in offering the use of their facilities both for inspection of their projects and for overnight stops.

Each day's run was outlined to the driver of the mess truck since the mess truck had to stop to buy food and other necessities and often followed a different route than the bus. Both bus and mess truck personnel were supplied with red cardboard arrows, and the first one arriving near the stopping place put up arrows indicating the way in. This often proved very helpful.

Mr. and Mrs. Allan Bonwill of East Haven were in charge of the mess truck. They were both interested in conservation and the

out-of-doors. Both were experienced in Boy Scout and Girl Scout work and had camped out and travelled extensively. They purchased the food, ice and other necessities at towns through which they passed. Each day 5 members of the tour were appointed as K.P.s to assist with the work of preparing meals. They started their day helping prepare the evening meal, helped with breakfast and the preparation of sandwiches for lunch and the actual serving of the noon-day lunch. Supper and breakfast were hot meals, lunch a cold meal. At least once a week we planned to eat one or more meals at a restaurant to give the cook a rest. When the mess truck was delayed for repairs, the tourers ate in a restaurant. Our meals were well balanced, varied, tasty and nutritious. An abundance of celery, lettuce, tomatoes and fruits provided the roughage so essential on such a trip. The cost of food was very reasonable, and the pleasure of eating our meals out-of-doors was great indeed. Probably no single factor made for a closer friendship among the group than all of us eating together, helping prepare and serve the meal and clean up afterwards, helping pack up the mess truck in the morning and getting under way. The usual banter and give and take while working with the other members taught all of us how better to adjust overselves to our fellow tourers.

Our day usually started about 5:30 or 6:00 A.M. with certain members habitually getting up early, starting breakfast, rolling our bedrolls and baggage and bringing it all to a central point for loading. Breakfast about 7 and then washing up and packing up the mess truck. We usually got on the road by 8, visiting projects, looking at points of interest to us, or travelling if the day's run was a long one. The loudspeaker was used to make announcements or for teaching purposes, especially if a local expert rode in the bus and called attention to points of interest. One or more rest stops were called each half day, and often a cup of coffee or an ice cream cone purchased during the stop were refreshing. Always the chance to stretch our legs was a great pleasure, in fact it was a necessity. We tried to find a pleasant spot for our noon-day lunch. We usually reached our overnight stop around 6 in the evening, although occasionally it was later. That was one of the difficulties of such a trip—there just weren't enough hours in the day!

Then came choosing a place for the mess truck, a place for our sleeping bags and our tents if they were needed. Then supper and cleaning up afterward. Many evenings we had local experts discuss their special projects with us. Sometimes controversial matters were taken up by several speakers. Sometimes we gathered around the campfire and sang songs and told stories. Always we sang on the bus, forenoons, afternoons and evenings, especially if we travelled late.

Between times there always were notebooks to keep up to date, letters to write and good talk with other members of the "gang." Whenever time permitted, stops were made for photographs. While inspecting projects, cameras were in frequent use. This resulted in thousands of colored and black and white pictures, many of which were duplicated and exchanged, so everyone that wished could get material for use in lectures and in the school room. Specimens were collected, but as space was at a premium, most had to be mailed home. Always the inevitable postcards and souvenirs were to be purchased and sent home. We were always busy and when we went to bed, we usually dropped off to sleep at once.

It would be impossible to describe all of the places we visited and the projects we saw, but a few of them certainly should be mentioned here. Our first stop was near Washington, D. C., for a visit at the Beltsville Agricultural Research Center and the Patuxent Research Refuge. Here we viewed wildlife, forestry and soil conservation and ate our meals in a lively woodland area—our trip was starting well! Down over the Skyline Drive of the Shenandoah National Park where a park naturalist served as our guide. A stop at Sweet Briar College and on to Black Mountain college near Asheville, N. C., where we rested Sunday. A visit to the famous Biltmore Estate, the Bent Creek Forest Experiment Station, the Pisgah National Forest with its historic significance as the home of Dr. Schenck's Biltmore Forest School. A visit to the Coweeta Hydrologic Laboratory gave us a wonderful chance to see the relation between forests and water. A view of the devastation brought on by smelter fumes, cutting and fire at Copper Hill in Tennessee was not soon to be forgotten. A most pleasant stop at Athens College, Alabama, and a visit to the T.V.A. forest nursery, phosphate plant and wood molasses experiment followed. Across Mississippi with a glimpse of the sharecroppers raising cotton and on to Crossett, Arkansas, for a thorough view of the lumbering operations and the forest experimentation being carried on there. Into Texas for a day's rest and study at the Hagerman Wildlife Refuge, and on west to the Texas Technological College at Lubbock. Grazing, water and mesquite were some of the problems we studied. Into New Mexico for a visit to a potash mine and the Carlsbad Caverns, then north for irrigation and the White Sands National Monument. The Jornada Range Reserve gave us a good view of grazing problems and several Soil Conservation Service men showed us some of the soil and water problems in that area. Sunday at Albuquerque where the Forest Service men were most cooperative in showing recreational facilities in the Sandia Mountains. West to see Acoma and the ancient Indian cultures at Chaco Canyon. Then on to Flagstaff Arizona where we heard much about

the present Hopi and Navajo Indians. Yellow pine forestry practices were here encountered. The sublime Grand Canyon and man's efforts at Hoover Dam and Lake Meade were next visited. Across the desert to Southern California and a glimpse of the water problems of the San Dimas Experimental Forest as compared to the Coweeta area in North Carolina. The San Joaquin Valley and the Big Trees, Yosemite and Berkeley followed. The redwoods and their utilization, as well as their beauty, led us into Southern Oregon and the Douglas fir. A visit to the Oregon Agricultural College and a biological station at Coos Bay. On to Portland and the hospitality of Reed College and the complex problems of the Columbia Basin. The Mt. Hood country and Hood Valley agriculture, the Wind River Forest Experiment Station, the Weyerhaeuser Lumber Company and their St. Helen's Tree Farm, the Simpson Logging Company and more of the Douglas fir were next investigated. The Manning Seed Company and their trade in forest tree seed was of interest. A visit to some of the state parks in Washington and Mt. Rainier and we were started back home. The Grand Coulee Dam where we were most royally guided over the project and the use of the impounded waters for irrigation were inspected. The Palouse wheat country and its erosional problems. Idaho forestry and the lively conservation group at Missoula, Montana. Glacier National Park and the Blackfoot Reservation grasslands. Then across the plains of Montana with its irrigation and its dry land farming, its small lakes serving as game refuges such as Lake Bowdoin, Fort Peck Dam and then on into North Dakota to another duck breeding area, Upper Souris.

Down to see the Northern Great Plains Experiment Station at Mandan where a hail storm struck as we arrived and destroyed the year's experimental work. Then eastward into Minnesota and its rich farm land, its source of the Mississippi, its iron ore mines, and its forests at Cloquet and Duluth. Across Wisconsin and into Upper Michigan where we got well soaked by unexpected rains. Down to Higgins Lake where the hospitality of the Michigan Conservation Department was so much enjoyed. Into and across Ontario to Niagara where we reviewed our tour with a series of pantomime stunts recalling the funny things that had happened on the trip. Across New York, now in a hurry to get home, and into Connecticut where we arrived August 25, having been on the road since June 27.

Unpacking, repacking, greeting our friends and relatives and saying tearful goodbyes to the tour members, we soon broke up to go our several ways. Sleeping indoors was a hardship at first, but we soon got used to it. In October we had our first reunion—27 of the 32 attending. We looked at slides and pictures till all hours of the morning. Several other reunions have been held since. I have sent out

newsletters at intervals, as well as new conservation pamphlets as they have been published.

Notebooks were sent in by those desiring the 6 units credit allowed by the University. The quality of these notebooks has been very high, the accuracy of the facts and concepts has been excellent. Best of all, the tour members have made much use of their knowledge in their schools and in their communities, as well as in a new awareness of the problems of conservation as they appear in our newspapers, magazines and books.

On the whole, I feel that the tour was very much worthwhile, justifying all the effort required to organize and lead it. I know that the tour members feel the same way about it. Nearly two years of planning went into it, well over 2,000 letters were written and the help of many persons, and of my family in particular, was given without stint.

To the members of the tour, as fine a "gang" of travelers as it has ever been my good fortune to know, I am deeply grateful for a very worthwhile and satisfying experience.

SCIENTIST SUPPLY DOUBLED IN 12 YEARS

This nation has doubled the number of its scientists in the past 12 years. So has Russia.

The supply in this nation is still short of the demand and will remain so for several years to come. So Dr. Dael Wolfle, director of the Commission on Human Resources and Advanced Training told the American Association for the Advancement of Science.

We now have about 200,000 scientists, about 46,000 of whom have earned Ph.D.'s or the equivalent, Dr. Wolfle revealed. To this may be added about 500,000 engineers and about 300,000 physicians, veterinarians and others in the health field.

"We can take considerable satisfaction in the amount by which we have expanded our own scientific resources in the past dozen years," Dr. Wolfle said. "But the USSR can take as much satisfaction in its efforts. The comparison gives no grounds for complacency that we have insured our continuing scientific superiority."

Looking ahead, Dr. Wolfle saw the most optimistic picture as being in the production of new Ph.D.'s. During the years just ahead, he said, we will have three times as many Ph.D. scientists with from three to eight years of experience as we have had during the recent past.

"Within this young and vigorous group we can expect to find many good research investigators and many good project and laboratory directors," he pointed out.

However, the production of scientists with bachelor degrees, needed to help the Ph.D.'s, to teach neophyte scientists, is not so good. During the next five years, about 190,000 will receive bachelor's degrees, only about two-thirds as many as in the past five years. Many of these are in ROTC or have been deferred to complete their college educations and therefore will be in the armed forces. Some have no intention of being scientists, some will marry, some will become teachers. Only a comparatively small number will be available for immediate scientific work.

NEW DEVELOPMENTS IN ATOMIC ENERGY*

WARREN J. MCGONNAGLE
Argonne National Laboratory, Chicago, Ill.

Next Tuesday, December 2, will mark the tenth anniversary of the first controlled release of atomic energy by man. Therefore, I consider it a great honor and privilege to be asked to address this group on the subject of atomic energy. Many interesting developments have occurred in this decade. However, I shall limit my discussion to one particular phase of this subject, namely, the nuclear reactor field. Although there are many problems involved in utilizing nuclear fuel for power production, it is not too optimistic to assume

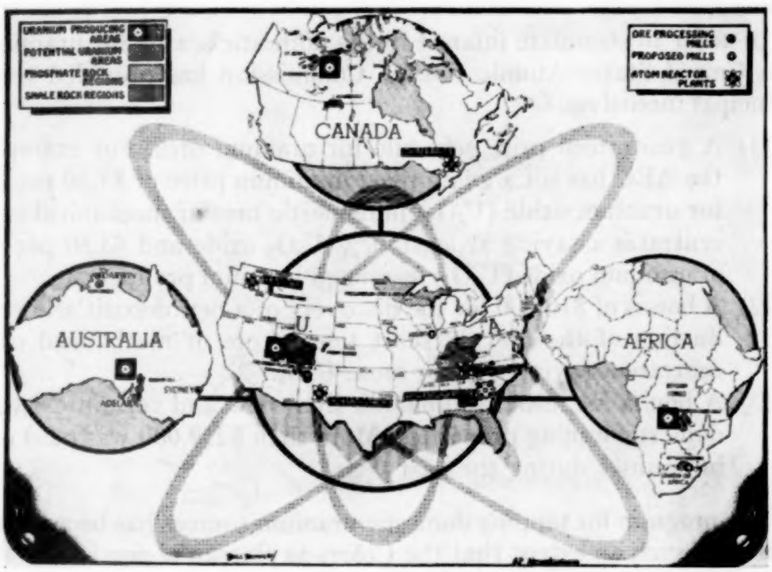

FIG. 1. Uranium map.

that solutions of these problems will be found. The extent of the use of nuclear produced power will ultimately be determined by the available raw materials from which nuclear fuel can be obtained.

Prior to the start of the nuclear energy program, uranium was a relatively unknown and little used element. A considerable quantity of uranium bearing ores had been mined but were worked for their radium or vanadium content, the uranium being a practically useless waste. This was rather fortunate for the atomic energy program, since

* Presented before the Physics Section of the Central Asosciation of Science and Mathematics Teachers at the Edgewater Beach Hotel, November 28, 1952.

there was a considerable stockpile of uranium bearing material above ground and available for processing.

With the advent of the atomic age, a widespread search for uranium began. Natural uranium is widely distributed throughout the entire world but most of the deposits contain so little uranium that it is unprofitable to work them. Geologists estimate that uranium makes up four parts per million of the earth's crust, this amounts to 10^{15} tons of natural uranium. It is also estimated that in the oceans, there are 10^{10} tons more of uranium.

Production from established sources is increasing, new production areas are opening up and exploration is being pushed to find new deposits. Figure 1 shows some of the now known and potential uranium producing areas of the world.

Here are some details on the uranium program both at home and abroad.

In order to stimulate interest in the domestic search for uranium, the United States Atomic Energy Commission has provided three principal incentives.

(1) A guaranteed price schedule for uranium ores. For example, the AEC has set a guaranteed minimum price of \$3.50 per lb. for uranium oxide (U_3O_8) in domestic ores or mechanical concentrates assaying at least 10% U_3O_8 oxide and \$3.50 per lb. of uranium oxide (U_3O_8) in refined uranium products.

(2) A bonus of \$10,000 for the discovery of a new deposit and production of the first 20 short tons of ore or mechanical concentrate assaying 20% or more U_3O_8.

(3) A bonus for initial production from new and certain existing domestic mining properties. More than \$250,000 was paid out in bonuses during the past year.

The program for tapping domestic uranium sources has been accelerated to such an extent that the Colorado plateau region is now the second largest source of uranium in the world. Eighty per cent of the uranium produced in the United States comes from this region. Figure 2, the Colorado plateau region covers an area of approximately 130,000 square miles of eastern Utah, northwestern New Mexico, northeastern Arizona and that portion of Colorado west of the Rocky Mountains. Some 200 uranium mines are now in operation in the plateau. Nearly 5,000 people are taking part in uranium mining and refining activities. More than \$30 million a year of private capital is being spent here.

Over 100 uranium-bearing minerals are now known to exist in the world but in the plateau area the uranium occurs chiefly in the mineral carnotite. It is a sedimentary type of deposit, usually found

as a powdery mass in sandstone. Because the deposits are so scattered, uranium mining covers a wide area in the plateau. The ores contain 0.1–0.4% U_3O_8. Because the individual deposits are scattered throughout the sandstone, there are probably many deposits yet awaiting discovery. Unusual problems in exploration and production have arisen because of the irregular distribution of carnotite ores in the Colorado plateau region. To solve some of these problems, the AEC built necessary roads and lent financial assistance to mining projects. Figure 2 also shows that the United States has uranium mills for processing raw ore into uranium oxide at Uravan, Rifle, Grand Junction, Durango, and Naturata in Colorado, at Hite, Salt Lake City, Monticello, Utah and at Grants and Shiprock, New

FIG. 2. Colorado Plateau region.

Mexico. The AEC has ore buying stations at Marysville, Monticello and Greenriver, Utah, and at Grants, New Mexico.

There are promising deposits in the Colorado front range and in region of the Sunshine mine in Idaho. The principal vein deposits of uranium known in the United States are those found in central and western Utah. There are uranium producing areas in the Navajo Indian reservation in Arizona.

Within the past two years uranium deposits have been discovered in the sedimentary formations rimming the southern part of the

Black Hills in South Dakota. The number of new discoveries in this district is increasing steadily and the extent of the known mineralized area is being pushed to the north and northwest from the vicinity of Hot Springs and Edgemont. The AEC has established an ore buying station at Edgemont, South Dakota to encourage production from the new deposits.

Uranium is widely distributed in low concentrations in many sediments particularly in phosphorites, black shales and lignites. Although these deposits are low grade, they represent huge potential reserves of uranium if recovery problems can be solved. The highest concentration of uranium so far discovered in marine sediments occur in deposits in Florida, Idaho, Wyoming and Montana. Although there is only 0.2–0.4 lb. of uranium per ton of rock, the extent of these deposits makes them a potential source for uranium. These deposits are also the principal sources for our phosphate fertilizer industry. Studies sponsored by the AEC have established the feasibility of recovering these small quantities of uranium as part of the process of manufacturing sodium phosphate chemicals and concentrated commercial fertilizers. The first commercial unit began operation as a part of the Blockson Chemical plant near Joliet, Illinois a few months ago.

The black slates found in Michigan, Minnesota and Wisconsin are promising sources of uranium.

In the Belgian Congo, continued exploration and development of the pitchblende veins has continued and a steady flow of raw material from this all-important source is being maintained. This region still continues as the chief supplier for the United States' ever expanding atomic program. Perhaps the most important large source of uranium developed in these post-war years is in South Africa, where the occurrence of uranium as a minor metal in gold ores has been known for many years. Recently an agreement was reached, whereby the United States and Great Britain have been given access to this large store of uranium. There are a total of 13 uranium-producing gold mines in South Africa of which 8 are either producing or will very shortly be in production of uranium from the gold-mining residues.

The Radium Hill deposits in South Australia have been developed into a significant producer. Within the past year important copper-uranium areas have been discovered at Rum Jungle some 60 miles south of Darwin.

The Eldorado mine at Great Bear Lake in Canada will continue to supply uranium for many more years. However, the most significant development in Canada has been in the Beaverlodge Lake area

of northern Saskatchewan. It is believed that this area may prove to be the richest source of uranium in North America.

Uranium deposits are known to exist in several sections of the Soviet Union, as well as in Czechoslovakia and in the German zone of occupation. The United Nations has been told that 400,000 or more slave laborers are working in Russian operated uranium mines in East Germany and many thousands more are working in Soviet controlled mines in Czechoslovakia.

Simultaneously with this development of uranium sources, progress has been made in the reactor field directed toward the industrial applications of atomic energy.

Underway at this time is a large program whose objective is to utilize the reactor heat source in power plants for ship propulsion. The power requirements of ships and of naval vessels, in particular, are high. A large carrier, for example, may have a propulsion plant capable of producing approximately 140,000 kilowatts. The progress made in this program can be expected to contribute greatly to the technology of power producing reactors in general. The nuclear ship propulsion program, which is being sponsored jointly by the Navy and the Atomic Energy Commission, consists of the naval submarine program and the naval large ship reactor program. The naval submarine program consists of two distinct efforts, each of which has as its goal an operating nuclear power submarine. The first will be powered by the Submarine Thermal Reactor (STR), which is being developed by the Westinghouse Electric Corporation and the Argonne National Laboratory. This reactor will operate with thermal neutrons and will use light water as the heat transfer medium. The second submarine program, the Submarine Intermediate Reacter (SIR), is being developed by the General Electric Company at the Knolls Atomic Power Laboratory. This reactor will operate with neutrons of intermediate energy and use liquid sodium as the heat transfer medium.

In each case, a prototype power plant, identical in most respects with the one which will be installed on the submarine, is being built on land for testing. Using the experience gained from the land-based models, other plants will be built for the submarines. The STR land-based plant is being constructed at the National Reactor Testing Station near Arco, Idaho, and is scheduled to operate in the near future. The land-based plant for the SIR is being constructed at West Milton, New York, about 18 miles north of Schenectady.

The keel of the USS Nautilus, into which the STR will be installed, was laid by President Truman on June 14, 1952.

The application of nuclear power to a submarine will greatly im-

prove its performance. No longer being dependent on oxygen from the atmosphere, it will be capable of operating submerged for extended periods of time. It will be able to travel at over 20 knots per hour for thousands of miles before refueling if necessary.

The advantages of nuclear power can also be applied to large vessels such as aircraft carriers. For example, the bringing in of large quantities of air to the boiler and the discharge of hot stack gases presents a complex problem in the new flush-deck carriers of the *Forrestal* class. A nuclear power plant would eliminate both. Furthermore, the space normally occupied by large quantities of fuel oil could be devoted to making the ship a more effective weapon. A program leading to the eventual application of nuclear power to such vessels was announced by the Atomic Energy Commission on August 1st of this year.

On March 31, 1952, the Materials Testing Reactor (MTR) located at the National Reactor Testing Station, Arco, Idaho began operation. The MTR was designed to produce a neutron radiation more intense than any other reactor built to date. The MTR provides much needed facilities for determining the effect of intense radiation on materials considered for use in the structures, heat transfer systems, and shields of new reactors. It contains more than 100 ports in which specimens can be exposed to neutron bombardment. While the reactor operates primarily on thermal, or slow neutrons, it also can subject specimens to neutrons with intermediate and fast energies.

The Experimental Breeder Reactor (EBR) also located at Arco, Idaho began operation in August 1951. On December 20, 1951, the world's first production of a significant amount of electricity from a nuclear reactor heat source was achieved when four bulbs were lighted. The following day, the external electrical supply to the building was disconnected and the entire power load was carried by the reactor boiler-turbine-generator system.

The EBR was not built primarily for generation of electricity, but for the purpose of demonstrating and studying the possibilities of breeding. However, it will be a useful tool for carrying out experimental studies on the generation of electrical power by nuclear reactors.

On the average 2.5 neutrons are released for each U^{235} atom that undergoes fission. The theory behind breeding is that there are sufficient neutrons released in fission to provide: (a) one neutron to maintain the chain reaction (b) one neutron to produce an amount of fissionable material just equal to that consumed, and (c) $\frac{1}{2}$ neutron to produce fissionable material over and above the replacement of that consumed. Natural uranium contains only 0.7% of the fissionable U^{235}. However, if U^{238} is bombarded with neutrons the element plu-

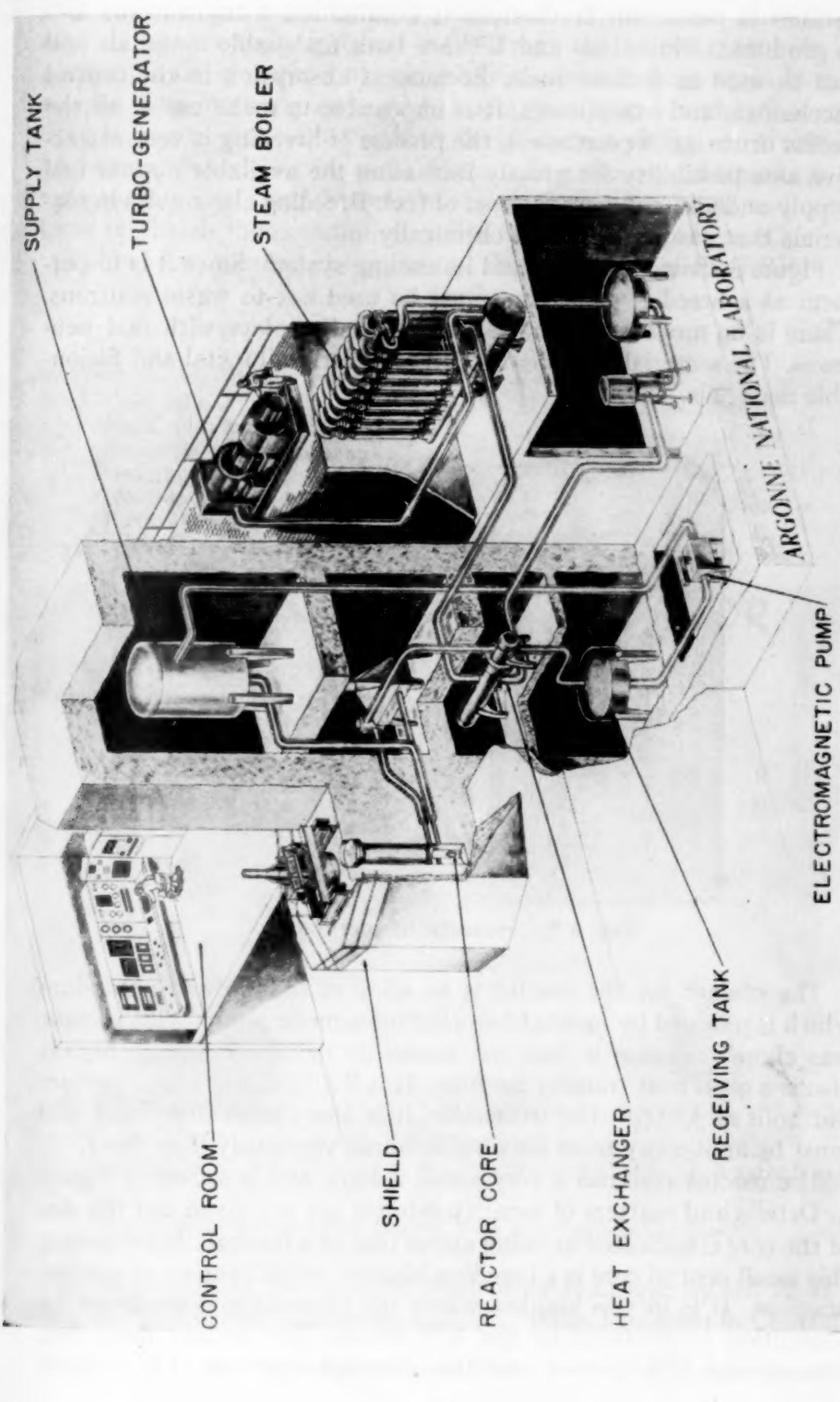

FIG. 3. Experimental breeder reactor and steam-electric generator.

tonium is produced. If thorium is bombarded with neutrons U^{233} is produced. Plutonium and U^{233} are both fissionable materials and can be used as nuclear fuels. Because of absorption in the control mechanism and other losses, it is impossible to make use of all the excess neutrons. Nevertheless, the process of breeding is very attractive as a possibility for greatly increasing the available nuclear fuel supply and also reducing the cost of fuel. Breeding also results in materials that can be separated chemically.

Figure 3 shows the EBR and its cooling system. Since it is to perform as a breeder, great care must be used not to waste neutrons. There is no moderator, and the reaction takes place with fast neutrons. The materials of construction are nearly all metal and fissionable materials.

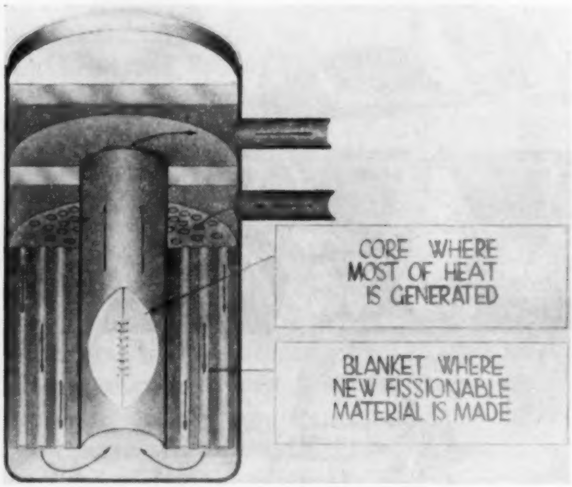

FIG. 4. Experimental breeder reactor.

The coolant for the reactor is an alloy of sodium and potassium which is pumped by means of an electromagnetic pump. This coolant was chosen because it does not moderate neutrons appreciably. It also is a good heat transfer medium. It is liquid at room temperature but boils at 1500°F. Unfortunately, it is also chemically active and must be kept away from air since it burns vigorously if exposed.

The reactor core has a very small volume and is shown in Figure 4. Details and matters of security interest are not given but the size of the core is indicated as being about that of a football. Surrounding this small central core is a breeding blanket which consists of natural uranium. It is in this blanket where the plutonium is produced by absorption of neutrons by the U^{238} atoms. The coolant flows first through the U^{238} blanket and then through the core. The coolant

which is now hot both thermally and radioactively flows through a heat exchanger to a receiver tank. From the receiver tank it is pumped to the elevated storage tank from which it flows again to the reactor. The receiving and supply tanks, pump, and heat exchanger are put in concrete-walled cells to shield against radiation. A reflector surrounds the reactor tank. Surrounding the core, blanket, and reflector is a shield which consists of a thick section of lead and concrete to absorb the radiation given off in the fission process.

Table I lists some of the operating characteristics of the EBR.

TABLE I. SOME OPERATING CHARACTERISTICS OF EXPERIMENTAL BREEDER

Core volume	a regulation football
Na-K alloy temperature at exit	660°F.
Steam pressure at turbine	400 psi
Generator capacity	250 kw
Neutron flux	6.5×10^{14} n/in.^{2}/sec.
Power density	4.0 kw/in.^{3}

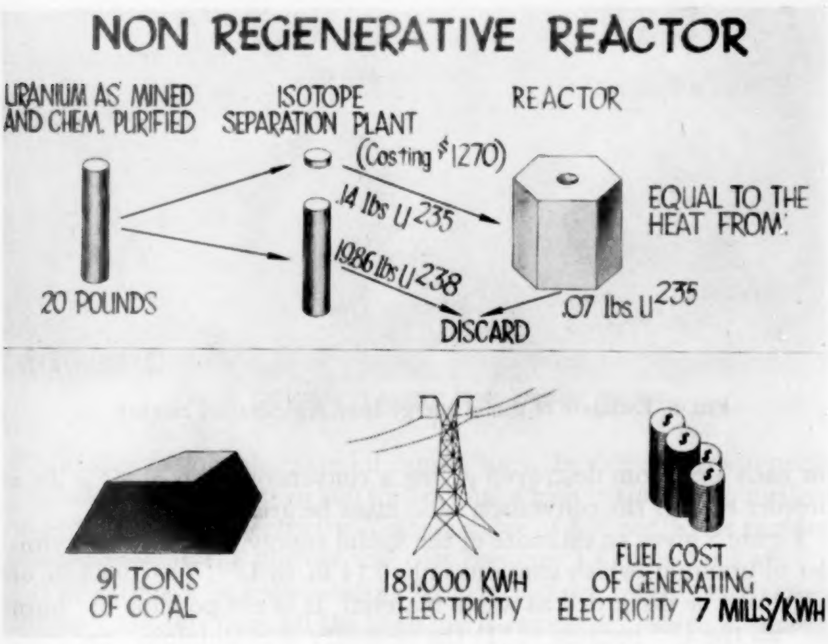

FIG. 5. Estimate of useful Energy from non-regenerative reactor.

In the September 1952 issue of Nucleonics[1] is a paper by Dr. W. H. Zinn, director of our laboratory, entitled "Basic Problems in Central

[1] *Nucleonics*, Vol. 10, Sept. 1952. Pgs. 8–14. Figures 3, 4, 5, 6 and 7, and Table I are taken from this paper.

Station Nuclear Power." In this paper he discusses the economics of nuclear power. Dr. Zinn discusses three cases: (1) a non-regenerative reactor (2) a regenerative or converter reactor and (3) a breeder reactor. A non-regenerative reactor is one which consumes fissionable material and produces only heat energy. Earlier it was mentioned that on the average 2.5 neutrons are emitted in the fission process. One of these neutrons must be used to maintain the chain reaction. In a non-regenerative reactor, the 1.5 remaining neutrons are lost. In a regenerative reactor, all the 1.5 neutrons are not lost but less than 1 of the neutrons is used for producing new material. For example, in the first heavy-water reactor built 0.8 of a plutonium atom is formed

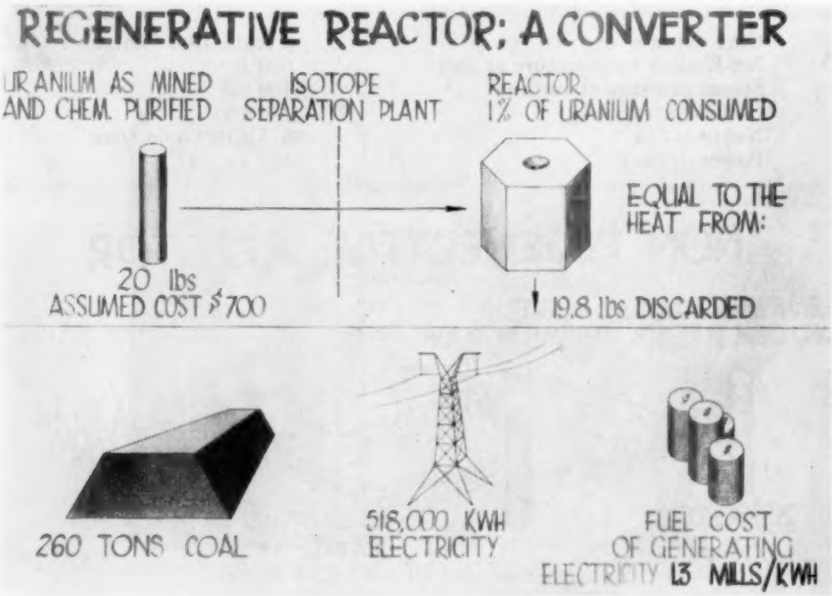

FIG. 6. Estimate of useful energy from regenerative reactor.

for each U^{235} atom destroyed giving a conversion ratio of 80%. In a breeder reactor the conversion ratio must be greater than 100%.

Figure 5 gives an estimate of the useful energy from a 20 lb. cylinder of uranium, which contains only 0.14 lb. of U^{235}. The 19.86 lb. of U^{238} must be discarded as waste material. It is not possible to "burn up" all the U^{235} because of (1) the necessity of maintaining the critical loading of the reactor; (2) the poisoning of the reactor by the accumulated fission products; (3) the difficulty of maintaining the physical characteristics of the fuel when a great part of it has been converted to new atoms. Arbitrarily, it is assumed that only one-half of the U^{235} is actually used and the rest discarded as waste. As-

suming an efficiency of 25% for the entire system, the heat produced is equivalent to that obtained from 91 tons of coal or equivalent to 181,000 kilowatt hours (kwh) of electrical energy. If the figure of \$20 per gram is used for uranium (at the present time, this figure is certainly low) the cost of the electricity is 7 mills per kwh for fuel alone.

Figure 6 gives an estimate of the useful energy from a 20 lb. cylinder of uranium used in a regenerative reactor with a conversion ratio of 80%. In this case, the original U^{235} is stretched to 5 times as much fissionable material. $(1+0.8+(0.8\times 0.8)+---=5)$. Assume only

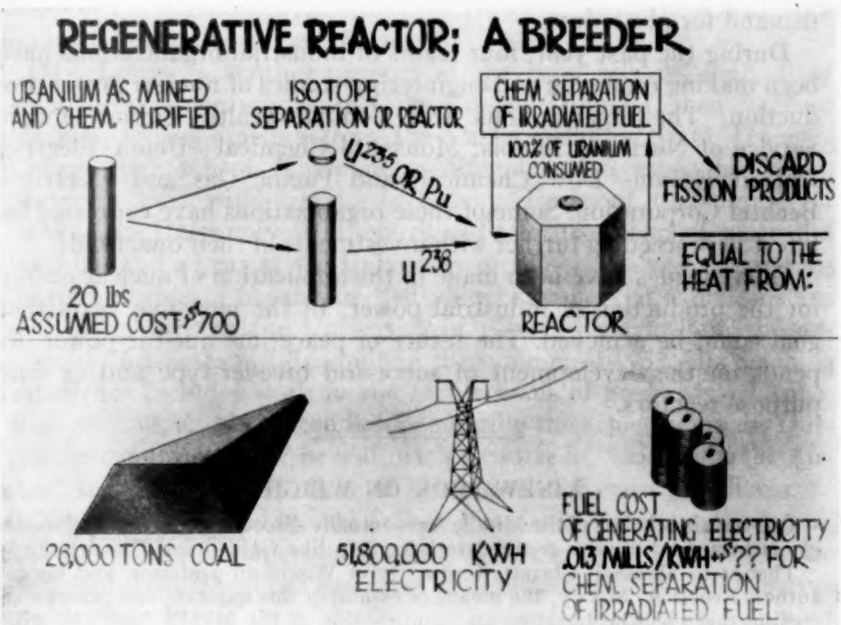

FIG. 7. Estimate of energy from breeder reactor.

1% of this fissionable material can be used. In this case, the energy produced is equivalent to 260 tons of coal which in turn, is equivalent to 518,000 kwh of electricity. Using a value of \$35 per lb. for purified uranium metal, the nuclear fuel cost becomes 1.3 mills per kwh.

The estimate of useful energy from a breeder reactor is given in Figure 7. In this case, all the uranium is consumed, which is equivalent to 26,000 tons of coal and produces 51,800,000 kwh of electrical energy. This makes the fuel cost 0.013 mills per kwh, if the value of \$35 per lb. is used for purified uranium metal. However, the process is not as simple as this, because it will be necessary to remove the fuel, repurify it and replace it in the reactor. Several such cycles may be necessary before all the fuel is burned up. This may be a costly

process. How much it will cost is not known. If this increases the cost of the fuel by a factor of ten, the fuel cost is still negligible. But if the cost is increased by a factor of 100, then the fuel cost is no longer negligible and the economic advantages are now borderline.

A fourth case should also be considered, this is a dual purpose or plutonium producing reactor. In this reactor, the heat energy released is used for generating electrical power and the plutonium sold to the government for military purposes. It is not possible to put down any values, because we do not have a dollar value for plutonium. The economics of this system are then directly linked to the demand for plutonium.

During the past year, four teams of industrial organizations have been making economic and engineering studies of nuclear power production. The organizations are: Commonwealth Edison—Public Service of Northern Illinois; Monsanto Chemical—Union Electric; Detroit Edison—Dow Chemical; and Pacific Gas and Electric—Bechtel Corporation. Some of these organizations have expressed interest in proceeding further with investments of their own funds.

Great strides have been made in the application of nuclear energy for the production of industrial power. In the next five years that goal could be achieved. The future of peacetime nuclear power depends on the development of successful breeder-type and/or dual purpose reactors.

A NEW BOOK ON WEIGHTS

Did certain scholars of the Middle Ages actually discover some of the principles of mathematical physics credited to later man like Galileo and Descartes?

Thanks to Marshall Clagett, University of Wisconsin professor, and his co-author, Ernest A. Moody, the means of exploring this question and others concerning the scientific tradition and contribution of the Middle Ages are being supplied to 20th-century students of the physical sciences.

In their book, "The Medieval Science of Weights," recently published by the University of Wisconsin Press, Clagett and Moody have translated into English, edited, and annotated certain treatises on the science of weights ascribed to Greek, Arab, and medieval scientists. Since around the beginning of the present century when historians began to realize that some of the men of the Middle Ages were "no mere copyists" and "made important additions to the materials which they inherited," the investigation of this discovery has been seriously hampered by inadequate editing or no editing at all of the ancient manuscripts, by the inaccessiblity of rare texts, and by the fact that most of these papers were in Latin.

Prof. Clagett is chairman of the UW department of the history of science. His work on the medieval treatises on weights includes a year—1950–51—of study in European libraries. He photographed on microfilm much of the written material investigated there and by this method was able to continue in the U. S. work with the content of the manuscripts.

The Wisconsin science historian received his M.A. degree from George Washington University in 1938; his Ph.D. from Columbia in 1941. He joined the staff of the University of Wisconsin in 1947 after a period of teaching at Columbia.

TWO NEW EDITORS

Nelson L. Lowry

Since Mr. George S. Fichter became editor of the *Fisherman* his time for editorial work on School Science and Mathematics became more limited and he has asked to be replaced. For this important place on our biology staff we are pleased to announce that Mr. Nelson L. Lowry, Dean of Boys and head of the science department of the High School at Arlington Heights, Illinois now is at work and will be pleased to hear from you.

Mr. Lowry is another product of the rural schools, graduating from the common schools in Coles County (Illinois), then received his high school diploma from the Eastern Illinois State Teachers College high school. There he continued and received his B.Ed. degree in 1937 with a major in botany. He spent the summer of 1938 at the University of Missouri, and after two years of successful teaching and a year at the University of Illinois, he was granted his masters degree in botany in 1940. Two summers at Northwestern and more work at the University of Illinois brought him the advanced Certificate in Education in the summer of 1952. His teaching experience includes work in the high schools of Stewardson, Anna, Blue Mound, and Wheaton before entering the armed sevrices. During the coming summer he will teach a course in "Science in the Air-Age" in the National College of Education at Evanston, Illinois.

He has contributed to *The Science Teacher* and *Science Education*, and has presented papers at the Illinois Academy of Science and the National Association for Research in Science Teaching. He is active in church and civic organizations and holds membership in a number of scientific and educational associations. His wife, Betty Jane Ford, was a home economics teacher, and his two children, Barbara Jean and Carl Leonard give promise of continuing the science work of their parents. Mr. Lowry's home address is 120 N. Forest, Palatine, Illinois.

John D. Woolever

In general science Mr. John D. Woolever of Mumford High School of Detroit now replaces Prof. Walter A. Thurber of Cortland, New York, whose work in the State Teachers College now requires his full time and energy. Mr. Woolever received his bachelor of science degree from Wayne University in 1944 and later the M.Educ. in science education from the same institution. He has had further graduate work at Notre Dame, the University of Michigan, and the University of Michigan Biological Station. In the 2nd World War

he was a Lieutenant in the U. S. Navy in the Pacific, the 7th Fleet and the Philippine Sea Frontier.

Mr. Wollever is a former elementary science editor of the *Metropolitan Detroit Science Review*. He is now a member of the Board of Directors of this club and treasurer of the Detroit Biology Club. He has held a number of important positions in other organizations and is now secretary of the General Science section of the CASMT. His contributions to teaching literature may be found in *Science Education*, the *Education Digest*, *Metropolitan Detroit Science Review*, and in SCHOOL SCIENCE AND MATHEMATICS. His home address is 16196 Kentucky, Detroit 21, Michigan, where he will be pleased to hear from anyone interested in promoting education in the general science field.

MICHIGAN COUNCIL OF TEACHERS OF MATHEMATICS

Fourth Annual Conference, May 1, 2, 3, 1953

The fourth annual conference of the Michigan Council of Teachers of Mathematics will be held at St. Mary's Lake Camp, near Battle Creek, on May 1, 2, and 3, 1953. Registration will be held on Friday afternoon, May 1, and the meeting will close with dinner on Sunday, May 3.

The program committee has designated "New Horizons in Mathematics" as the theme of the conference. The guest speaker and consultant will be Dr. John R. Mayor, President of the National Council of Teachers of Mathematics. There will be exhibits, demonstrations, and discussion groups on topics covering a wide range of interests. Among the sessions which have been planned are ones dealing with

1. New Teaching Techniques
2. Modern Learning Theories and Their Implications for the Teaching of Mathematics
3. Mathematical Instruments and Field Work
4. The Use of the Slide Rule
5. Applications of Mathematics in Industry
6. The Mathematics Teacher and Guidance
7. The Teaching of Arithmeitc
8. Mathematical Films
9. "Dimension *X*"
10. Dissecting Polygons

Thus there will be programs of interest to all teachers, whether they teach in elementary schools, junior or senior high schools, or colleges. Moreover, the camp affords excellent recreational facilities. This is the best opportunity Michigan affords for its mathematics teachers to get acquainted, exchange ideas, and have a good time together. All mathematics teachers, whether in public or private schools, are invited to attend for the full duration of the conference or for as much of it as they can.

The camp is beautifully located on St. Mary's Lake. It has accommodations for nearly 150 persons. Meals are served in the main dining hall, and there are dormitory-type sleeping accomodations. The charge is modest. Inquiries and reservations may be sent to Miss Geraldine Dolan, Cass Technical High School, Detroit, Michigan, or to Mr. Don Marshall, Dearborn High School, Dearborn, Michigan.

POINT FOUR AND AMERICAN SCIENCE TEACHING*

Cedric Seager

Chief—Iran Division, Technical Cooperation Administration, Department of State, Washington, D. C.

I am particularly pleased to be the guest of this distinguished Convention today because it is less than two weeks since, six thousand miles away from here, I was observing the work of Point-4 among people hungering for knowledge.

The value of the work that American teachers are doing in less developed areas cannot be over-estimated; its drama is one of the great adventures of this century. Its significance may well make the difference between peace in our time and the obliteration of all that we cherish most dearly of our civilization. A terrible burden of responsibility has been placed upon our shoulders. I want to describe for you this morning how we are discharging that responsibility.

Let me begin with a personal experience.

I had been sitting for hours on end in a crowded room in Tehran with a group of American educators, public health officers, agricultural experts, and others, while they described for me their early work among the people of Iran.

It was a distressful story. I had spent thirty-five years of my life in the Near East and was prepared for some of the things they had to describe. I had visited the Nile delta and I thought that I had experienced the ultimate in nightmare existence. But I was not fully prepared for what I heard that morning.

It was not only, as some of you might suppose, a story of the difficulty of adapting the shining instrument of our highly developed technical skill to an out-of-date economy. It was a story, also, of the ravages of centuries of neglect; of a point reached where human misery and despair besought the attention of all the arts and sciences at our disposal.

Fifty per cent of all the children born in Iran die before they reach the age of 12 months. Fifty per cent of the survivors die before reaching the age of 5. Malaria is one of the scourges that kill, but abysmal ignorance regarding all that pertains to hygiene takes even heavier toll; I learned that morning of one village in northern Iran where of the last hundred births 99 had died. The hundreth was saved only because one of our health nurses arrived on the scene just in time to save the infant from the primitive ministrations of the local midwife.

From that meeting, I went to the city of Meshed in north-eastern

* Speech delivered to Central Association of Science and Mathematics Teachers in Annual Convention at Chicago, Illinois, on November 29, 1952.

Iran, not far from the Afghan frontier. I went with a teacher from one of our Utah Colleges. His job was to tackle the problem of primary education in an area almost as wide as the State of Texas. That first evening, over almost impassable roads, we drove further eastward to a large village where camera equipment had preceded us for the showing of two films; one on pure water and one on microbes. (Pure water is something the average Iranian knows nothing about. His source of supply is an open ditch running through the city, town, or village—and from this he draws his drinking water, in this he does his washing, and into this he discharges his sewage.)

Darkness had fallen by the time we arrived. The screen was set up in the village square. About the square, hundreds of peasants squatted on their haunches; the men in front, the women, veiled and bashful, in the background. For all of those present, many of whom had trudged ten to fifteen miles over dusty roads for the occasion, this was their first experience of movies. An air of excitement prevailed. The elders of the village greeted us warmly. They brought us bowls of delicious fruit to eat. They wanted us to be assured of their friendship.

One of our American technicians attended to the equipment and one of our Iranian technicians, in the simplest of language, gave a short talk on sanitation. The film, most skillfully prepared in Iran itself by members of a Syracuse University film unit, was in the Iranian tongue—or Farsi, as it is called.

Here, then, was one aspect of our modern science and our learning at work.

How would it be received?

What would it achieve?

The event was one of the most thrilling experiences of my life. The story the first film depicted was of the use of water in a typical village. The habits of the people in their ignorant handling of the water was graphically illustrated. A sanitary expert was shown at work, first drawing samples of water from village ditch and well; then analysing those samples in a laboratory. The story of microbes was told in a manner that could be understood by the simplest mind and scenes were shown from the daily lives of these people that were only too tragically illustrative of what happens when elementary principles of hygiene are ignored. The second film was in the form of a cartoon sequence showing microbes, many times magnified, launching their attack by day and by night upon the occupants of the village. Both pictures highlighted the simple fundamentals of sanitation and hygiene and showed what steps the peasants could take to protect themselves, once the danger was recognized.

The crowd sat for the most part in tense silence—although I over-

heard enough to realize that our story was being driven home—and at the end the crowd broke into excited conversation, exclaiming "By God, that is the truth."

"These things are new to us."

"Many of those things we can do to protect ourselves," and so forth.

They were not so ignorant that they could not understand—and when the films had been shown, although the hour was late, although many had weary miles of walking ahead of them, with work in their fields at dawn again the following day, they asked us to run through the films a second time.

Point 4 at work: and nowhere more effectively.

I have dwelt on that story because it goes to the very heart of our problem—the saving of lives, the carrying of our work right down to the village level, where the mass of humanity lives.

Their salvation is as much our responsibility today as if our own lives depended upon it. For Communism would have it otherwise. Their misery is Communism's breeding ground. Communism battens upon their ignorance and exploits their misery. We have only to stand idly by and a dark future indeed will close in on us.

But we are not standing idly by. As the late Dr. Henry G. Bennett, our leader, said: "A billion people have found a window into the Twentieth Century. It is up to us to provide them a door."

From your ranks have come willing hands to open that door. There could not be a closer association between what you, as teachers, are doing and what we of Point 4 are doing. With our weapons of technical skill and of science we have carried the war into enemy territory. We take the light of learning to areas of ignorance. In a generation where men and women have come to learn that disease is a scourge that can be obliterated, that poverty is by no means a necessary evil, we have put on the mantle of leadership and have gone out to grapple the problems of the most poverty-stricken areas.

We have sent our teachers into 35 countries to tackle basic problems of sanitation and health and general educaion. We go with the cooperation of all the Governments concerned, where enlightened leadership has recognized, as have we, that we cannot long enjoy the fruits of liberty if the billion people of whom Dr. Bennett spoke are not given a chance to free themselves of hunger and despair.

Let me emphasize that word "cooperation," for it is a key word in this task of ours that I am trying to describe. I have known too many people who have believed that we are urging this crusade of ours on unwilling governments. Yet not a single project is undertaken without the full collaboration of the leaders of the countries concerned. For every American technician engaged in this enterprise on alien

soil, there are ten foreign technicians working shoulder to shoulder with him. Their numbers are increasing daily, to the end that some day, having learned all that we have to impart, they may, unaided, carry on with the task.

Is there one among you who has not encountered some foreign student on the campus or in the area from which you come? That also is a part of our program; the giving of grants to promising students as well as to outstanding leaders for study in this country. This noble, essentially educational, program that Dr. Bennett launched in the name of the President and of the American people gathers momentum as it moves forward on 35 fronts. If it is sustained, if the time is given to use to complete what we have begun, it will constitute the greatest world-wide forward move in education since the days of the Renaissance; and it will have opened up that door of opportunity for the billion people of whom Dr. Bennett spoke.

I am anxious to keep your minds directed towards the level of our greatest undertaking: the village level, the level that has remained stationary for 2000 years of time. Our leading expert on land reform, Paul Maris, recently returned from Egypt. He was there engaged, in an advisory capacity, in the development of Egypt's land reform program. He has observed that, whereas in Biblical times the Egyptians made bricks without straw, he was now able to attest that bricks are today being made *with* straw. Dr. Maris added that, so far as he could see, no further single advance had been made by the Egyptian fellahin in the centuries that have elapsed since then, measured in terms of what they eat, what they wear and how they live. He could have said the same thing of the Iranian peasant, or of the peasants in many of the areas where Point 4 operates.

So you will find, wherever we work, American educators adapting what we have learned of basic teaching methods to the social and cultural habits of the people of these countries. The science of teaching itself is as important an instrument of our endeavor as are the fruits of American science. What we have learned of tactile and visual aids in our own classrooms, we have adapted and translated to meet the needs of the people among whom we work. Within the past month I have observed its successful application—among the children of the tribes in Kurdistan, in the cities, and in the dusty plains far to the East of the Persian Gulf.

We do these things, and then we find the teachers to do them in the pattern we have demonstrated. But when I talk of teachers, I am not talking of men and women having college degrees. There are those, but they are few in number and they are not to be found in the 42,000 villages of Iran or in the hundreds of thousands of villages in those other countries with which we are concerned.

We take the sixth and eighth grade boys and girls, the boys and girls who come from the village and who go back to the village, who know the village, its needs, its customs; yes, its tragedy, and we teach them how to teach in their turn. We have found that to be the best way, the quickest way, perhaps the only way, to achieve our joint purposes.

It works. I have seen it working. I have seen it working in the Veramin Plain where, in cooperation with the Near East Foundation and with the Ford Foundation, we are training in the arts of independence villagers newly endowed with land of their own by the young Shah. (Believe me, a man who has been a serf for 2000 years *needs* to be trained in independence.) I have seen it working in Shiraz, to the south, where one of our health nurses runs a teacher-training school for 15 and 16 year old girls who will go back to their villages and teach and train the girls of their own generation; not only how to read and write, but how to take such precautionary measures as will save their babies when they come and how to practice such simple sanitary precautions as will reduce that appalling mortality rate of which I have spoken.

From the village level upward, all that we do relates to American Science and to American Science teaching. Time does not permit me to run through the encyclopedic list of activities upon which we are engaged where the fruits of American Science are being brought to bear upon our problems.

Is it better wheat, better corn, better fruit, better vegetables? American science points the way. Is it better livestock, better animal care, elimination of livestock diseases, the uses of inoculation? American science points the way. Is it reforestation or broad experimentation in range management? American science points the way. Is it the elimination of malaria, the battle against trachoma, the problems of sanitation, the provision of pure water? American science and American engineering point the way. The list is as legion as are the needs.

To what end, you may ask? With what purpose in mind have we undertaken to help, if we can, in the solution of this gigantic problem?

A good answer would be that this must be the price of the freedom we enjoy; that the time has come for us to give back to the world some large measure of the blessed fruits of our labor, sharing our treasure with the needy before the needy are so exploited by the enemies of our freedom as to turn against us.

But in very truth, the history of our own times provides the answer. The force of circumstance has thrust upon us the mantle of world leadership. I do not think that we assume it unwillingly. The only kind of leadership we know is that which is born of our own

experience. We are free. We are independent. We are prosperous. The things that have made us free have made us prosperous: among these, our faith in the essential goodness of mankind, and our insistence upon a standard of equality of opportunity for all. Under these two banners we have achieved a measure of spiritual strength and scientific and material advantage never before reached in the history of the world. We know that we are engaged in a battle against those who deny that man has any rights whatsoever and who would destroy, if they could, all those things that we most dearly cherish. To win the battle, we need to plant the flag of freedom from ignorance and poverty and disease where these scourges provide easy fodder for our enemies.

If we Americans can measure up to our responsibilities, not only as teachers of science, but as friends and partners of our fellowmen, then ignorance and poverty and disease can be conquered, to the end that dignity and freedom may prevail.

EFFECTS OF THE ELIMINATION OF DISEASE

"A whole series of dilemmas face man because of his increasing life expectancy and the triumphs of modern preventive medicine," Sir Frank MacFarlane Burnet said Tuesday at the University of Wisconsin in concluding his five-week series of Knapp lectures on the problems of modern medicine and biology.

Dr. Burnet, world famed expert on virus disease, is a 1952 Lasker Award winner, professor of experimental medicine at the University of Melbourne, and director of the Walter and Eliza Hall Research Institute in Australia.

The most obvious of man's dilemmas is well known to everyone; the way in which populations in less advanced countries are increasing faster than the food supply, Dr. Burnet said.

"Virtual elimination of disease will mean economic catastrophe for tropical areas unless something is done to relieve the press of populations upon food supplies," he said.

"The only commonly acceptable answer is to increase the food supply by every possible means, which usually means irreparable damage to the agricultural land concerned," Dr. Burnet said. "The intellectual answer is to spread the knowledge of birth control methods and popularize their use, particularly by propaganda amongst the women.

"The hope," he added, "is that just as preventive medicine has become as it were prematurely effective in such countries, so it may be possible to effect an abnormally rapid reduction of the birth rate to the same sort of stabilized level that has been reached in Western countries."

The deliberate limitation of family size has been the most important cause of decline of Western birth rates, and there is "strong evidence that the incentive to limit the family to two children and success in doing so is strongly correlated with intelligence and economic security," he added.

"It is a process which everywhere has been associated with improved standards of living and rising levels of education and, whether we like it or not, represents a dominant aspect of human social development," Dr. Burnet said. "There is no reason to doubt that given time a gradual social amelioration in any country and in any race would be associated with the spread of birth control methods and a falling birth rate."

A MATHEMATICS CURRICULUM FOR THE GIFTED*

Reuben A. Baumgartner
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For a great many years we have emphasized in our school system the idea of mass education—the idea of an education for everyone. Most people have agreed with this objective but in its formulation and practice we have placed less emphasis on the education of the gifted. Today, we are faced with a great need for scientists and mathematicians in our country. Industry, as well as the government, is asking for outstanding men in these fields. You well may ask, "Are we not the leading scientific nation in the world?" That is true, but a great many of our eminent scientists have come from foreign countries. Until the beginning of World War II in the field of basic research and in applied mathematics, we were dependent on European countries for these people. During World War II a great many of our potential scientists were drafted. Although some of these young men continued their education after the war, this left a gap in our country of well-trained and experienced scientists.

There is the feeling that now, today, we need not worry about this problem since our colleges are crowded. This means many more college people are taking mathematics and science than ever before. The truth is that in all fields and particularly in mathematics, it takes a highly gifted individual to be outstanding and creative. If this is true, then we must see that as far as possible all the outstanding talent of the country must be recognized early. Certainly in order to keep ahead in our struggle for world peace we need to recognize and develop these students of outstanding ability to their maximum potential in order that they may contribute their best to the good of all civilization. The recognition and development of mathematical talent at an early age is extremely important for, as *Fortune* magazine points out:[1] "If the most creative years of a large number of scientists are charted on a graph, the peak comes about age thirty-two—mathematicians generally bud early—often before twenty-five." The Education Policies Commission recently published a pamphlet called "Education for the Gifted" which emphasizes the importance of the gifted student to society and which calls attention to ways and means of educating him. We quote from this booklet:[2]

* Presented at the Mathematics Section of the Central Association of Science and Mathematics Teachers at the Edgewater Beach Hotel, Chicago, November 28, 1952.

[1] Staff of *Fortune* magazine, "The Scientists," *Fortune* magazine, pp. 110, October, 1948.

[2] "Education of the Gifted," Educational Policies Commission of the National Education Association of the United States and the American Association of School Administrators, Washington 6, D. C., pp. 63–64, 1950.

"For these reasons, we recommend there be included in the secondary school program of nearly every highly gifted student the following:

(1) A foreign language; studied for a long enough time and with sufficient intensity to achieve, at least, reading mastery.
(2) Advanced mathematics; certainly through advanced algebra, probably through trigonometry, possibly through calculus.
(3) Additional study of the social studies with emphasis on history, beyond the amount taken by a typical high school student."

The exceptions as listed refer to students gifted in music or art who may omit advanced mathematics and the gifted youth who suffers from physical disability or from social or emotional disability. By highly gifted is meant individuals who fall within 1% of population. This article goes on to state that moderately gifted (next 10% of population) could also profit from more advanced mathematics but the need is not as compelling.

Since we have now seen there is a need to recognize and train gifted children, how can we best do this in the field of mathematics on the secondary level? My part of this topic will relate to a curriculum in mathematics for the gifted student. This presentation is therefore limited to the larger high school. However, some of the suggestions for curriculum might be incorporated through rotation of courses in the smaller high school. The topics as presented will be from actual courses of study in use in schools or as suggested in state courses of study.

Since there is no agreed definition of a gifted student, we will say that in an ordinary high school this will include 20 to 25% of the students. The Educational Policies Commission suggests this would include pupils with an I. Q. of 112 to 115 and above. Since frequently the group of students who are gifted are in the traditional courses in mathematics, our attention will be centered in that direction. The New York State Curriculum (1951 revision) gives an outline of mathematics for grades ten, eleven, and twelve. A unit in coordinate geometry is included in the tenth year plane geometry course. Such concepts as the distance between two points including the derivation of the formula are included. In grade eleven, the major content is algebra and trigonometry. Emphasis is placed on application to problems in mechanics, surveying, and navigation. In grade twelve, the main emphasis is on advanced algebra and solid geometry. Although these two units are separate, considerable emphasis is placed on integration of the two. In advanced algebra such topics as the review and extension of the linear function are included. This

means slope-point form, intercept form, distance between two points, equation of lines perpendicular as well as parallel to a given line, and the derivation of the equation of circle with center at (h, k). Instantaneous rate of change of the quadratic function interpreted as the slope of the tangent line is a part of this course. Also there is included a unit on polar coordinates (although optional). In solid geometry emphasis is placed on solving certain problems by trigonometry and logarithms. Two optional topics come into consideration which include solution of the right spherical triangle and coordinate geometry in space.

Grade nine and grade ten are primarily concerned with algebra in the Pennsylvania Course of Study. These two years take the pupil through quadratic equations. Grade eleven deals mainly with plane and solid geometry and a short unit on informal trigonometry. Much is said about the approach to geometry as developmental rather than memorization. The suggestion is made that perhaps we need not use a textbook at all in the teaching of geometry. Twelfth year mathematics includes trigonometry (one semester) advanced algebra, statistics, demonstrative solid geometry, and analytic geometry. The demonstrative solid geometry, four weeks in length, supplements the work in grade eleven. In analytic geometry, the study of the straight line and simple conics are included.

The mathematics curriculum of the Cass Technical High School, Detroit, Michigan, might be of interest to you. Although there is no special group for gifted students, limited enrollment means average or above pupils. Pupils in curricula of Art, Music, Printing, and Home Economics, are required to take algebra in the ninth year and plane geometry in the tenth grade. All other curricula require algebra the ninth year and the first half of the tenth grade. Plane geometry is required the second half of the tenth year and the first half of the eleventh year. Trigonometry is required the last half of the eleventh year with solid geometry, the first half of the twelfth year. In addition advanced algebra is an elective the last half of the senior year.

Washington, D. C. has a wide variety of courses in mathematics to challenge the gifted. Plane geometry and intermediate algebra have a pre-requisite of a year of algebra. Trigonometry, a one-semester course, may be taken by students having one semester of intermediate algebra and one year of plane geometry. Solid geometry is a one-semester course which has as its pre-requisite plane geometry and preferably trigonometry. It is suggested certain problems in this course be solved by trigonometry. Spherical trigonometry and its application to astronomy are also a part of solid geometry. College algebra is offered to those who have had intermediate algebra and plane geometry. Topics include complex numbers, variables and limits,

theory of equations, permutations and combinations, probability, determinants, analytic geometry, and elements of statistics. Analytic geometry, a one-semester course, has as its pre-requisite a course in trigonometry. Topics include straight line, circle, parabola, ellipse, hyperbola, polar coordinates, tangents, and normals. A course in surveying is also offered which has a pre-requisite of plane trigonometry.

Phillips Exeter Academy of Exeter, New Hampshire, has a program of interest to all of us. Students are sectioned according to ability with a more thorough course required of the best students. Extra work is required of these students. Ninth grade is primarily algebra, although some time is spent on geometry. Tenth and eleventh years are spent on a coordinated course of algebra and geometry as well as some trigonometry. Twelfth year is a combination of trigonometry and solid geometry, although a four weeks unit on the theory of equations is included. At the end of the ninth grade twelve to fifteen of the best students are selected for a special class in mathematics. These pupils take the equivalent of about the tenth and eleventh year mathematics in one year.

For grade twelve these pupils take a combination course of analytic geometry and calculus. Some of the topics include the straight line, circle, derivative, conic sections, maxima and minima, polar coordinates, integration, and definite integral.

The University of Chicago, University College, has a different plan for a mathematics program. Students entering the College are required to take a year course in mathematics called Mathematics 1. It should be remembered that a student may apply to the college for admission after two, three, or four years of high school. A knowledge of algebra and plane geometry is pre-supposed to enter Mathematics 1. Mr. E. P. Northrop, head of the University College Mathematics Department, points out in a recent statement that:[3] "If it be granted the study of mathematics is an appropriate part of a liberal education the aims of a mathematics course designed for such an education can be formulated somewhat as follows: The course should then help the student acquire facility and precision in the statement, organization, and communication of scientific ideas (logical discourse and deductive system). It should lead him to understand and to make use of the methods of mathematics (logic and intuition, analysis and construction, generalization and particularization), and it should supply him with certain facts, concepts, and techniques basic to exact science (relations and functions, number systems, analytic geometry, trigonometry)." The content of mathematics 1 is based on this idea. The book used has some of these headings:[4] Sets, Operations of Sets,

[3] Northrop, E. P. "A Brief Account of a Mathematics Program Designed to Follow Grade Ten."
[4] "Fundamental Mathematics," University of Chicago Press, Chicago, Illinois, 1949.

Relations, Functions, Mathematical Systems, The Field, Real Numbers, Real Numbers and Geometry, Real Functions and Their Graphs, The Circular Functions. Mr. Northrop feels this type of course is more appropriate than the conventional type of course. He states:[5] "That an order of learning in which first emphasis is placed on the mastery of a conception of mathematical systems and of skill in following their development makes mastery of systems subsequently studied more rapid, and more complete."

The University of Wisconsin's, Wisconsin High School has a twelfth year plan of mathematics which is worth consideration. The text used is "Basic Mathematical Analysis," by Dr. Glen Ayre of the Western Illionois State College at Macomb, Illinois. The content of the first four chapters centers about a study of the number system and the science of computation with primary emphasis on meanings and insight rather than mechanical manipulation. The idea of function concept is emphasized as a unifying agency for the subject matter content. It is one of the main objectives of the course to have students realize that the science of mathematics is a function of the underlying structure. Content includes trigonometry, college algebra, analytic geometry and introduction to calculus. Students who enter the University of Wisconsin, College of Letters and Science, who have had this course, are permitted to enter Mathematics 20, a course in calculus and analytic geometry. This enables entering Freshmen to complete calculus in three semesters rather than four. This course is also open to high school students who have had three to four units of high school mathematics, including advanced algebra and trigonometry, providing they do well in a mathematics placement examination.

The University of Illinois has approved twenty-three high schools in Illinois to give a fourth year mathematics course in college algebra and trigonometry. Students taking these courses from schools approved under this plan start at the University of Illinois in a course in analytic geometry. Calculus is then completed in an additional two semesters. Students entering the University of Illinois may secure five semester hours of college credit for these courses providing they do not use credit for these courses for admission to the University. Approval is on the basis of teacher training and inspection by the University. This plan has been in operation at Freeport High School for over twenty-five years with very satisfactory results. In Illinois, where the third year mathematics is usually one semester of algbera and one semester of solid geometry, some schools divide the second semester into two classes, one solid geometry and the other a con-

[5] Northrop, E. P., *op. cit.*

tinuation of algebra. In this second course, such topics as statistics, slide rule, trigonometry of the right triangle, are emphasized. Two schools having such a plan in operation are Proviso Township High School at Maywood and Freeport High School.

These suggested courses, with one or two exceptions, are similar to courses in operation in various parts of the country. My purpose in presenting this limited cross section is to give you ideas on changing or modifying your present program in order to make a more effective program for the gifted. It is encouraging to note that for the mathematically able, there is ample material to present a challenging mathematics program. This is necessary since as pointed out in the article in *Fortune*, many mathematicians reach their peak of productivity at an early age. We hope that teachers of mathematics will accept this challenge so that these gifted will be able to give to the world their maximum creativity.

Bibliography

1. "A Course of Study in Mathematics for Secondary Schools," Bulletin No. 360, Commonwealth of Pennsylvania, Department of Public Instruction, Harrisburg, Pennsylvania, 1952.
2. Ayre, H. Glenn. "Basic Mathematical Analysis" McGraw-Hill, 1950.
3. Cass Technical High School, Circular of Information. Board of Education, City of Detroit, 1951.
4. Cunningham, Harry A. "Some Challenging Problems in Teaching High School Science to Gifted Children, School Science and Mathematics, LII, pp. 373–380, May, 1952.
5. "Curriculum Adjustments for Gifted Children" Federal Security Agency. U. S. Office of Education, Bulletin 1946, No. 1.
6. "Education of the Gifted," Educational Policies Commission of the National Education Association of the United States and the American Association of School Administrators, Washington 6, D. C., 1950.
7. "Fundamentals of Mathematics," University of Chicago Press, Chicago, Illinois, 1949.
8. Kraft, Ona. "Providing a Challenging Program in Science and Mathematics for Pupils of Superior Mental Ability," School Science and Mathematics, LII, pp. 143–147, February, 1952.
9. MacDuffee, C. C. "What Mathematics Shall We Teach in the Fourth Year High School?" *The Mathematics Teacher*, XLV, pp. 1–5, January, 1952.
10. "Mathematical Needs of Prospective Students at the College of Engineering of the University of Illinois," University of Illinois Bulletin, 1951.
11. "Mathematics Course of Study for Senior High School Grades 10–12," Public Schools of the District of Columbia, Washington, D. C., 1946.
12. Northrop, E. P. "Mathematics in a Liberal Education." *American Mathematical Monthly*, 52, pp. 132–137, March, 1945.
13. Northrop, E. P. "The Mathematics Program in the College of the University of Chicago," *American Mathematical Monthly*, 55, pp. 1–7, January, 1948.
14. Northrop, E. P. "A Brief Account of a Mathematics Program Designed to Follow Grade Ten." A report on the College Mathematics Program at the University of Chicago.
15. Peckman, Eugene F. "Providing a Challenging Program in Mathematics

and Science for Pupils of Superior Mental Ability," SCHOOL SCIENCE AND MATHEMATICS, LII, pp. 187–193, March, 1952.

16. PRICE, G. BALEY. "A Mathematics Program for the Able," *The Mathematics Teacher*, XLIV, pp. 369–376, October, 1951.
17. Staff of *Fortune* magazine. "American Scientist" *Fortune* magazine, October, 1948.
18. "Tenth, Eleventh, and Twelfth Year Mathematics." Mathematics Syllabus Committee, The University of the State of New York, The State Education Department, Albany 1, New York, 1951 Revision.

CONCERNING THE OBSERVANCE OF SCIENTIFIC ANNIVERSARIES

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It is a commonplace practice for men to pay tribute to certain notable events and personalities in history, and this practice predominates in *religious* calendars. The observance of such holidays in *secular* events is now practiced on a much larger scale than ever before, and these "holidays" occupy a very large place in our society. Indeed, it is pretty nearly possible now to assign every day of the calendar year to some worthwhile commemorative event or person. Political holidays are particularly abundant, and these, of course, attest to the forceful ambition of men to be free. The observance of "scientific" events or persons does not yet occupy any significant place in our mores, but since we are now so staggeringly enveloped by technological achievement it seems appropriate that we remind ourselves in some humble way of the men who accomplished these wonders. Students and teachers at all levels should, I believe, give this matter some attention. These men are essentially physicists, although Legendre was an illustrious mathematician, Ramsay preeminently a chemist, von Guericke a "natural philosopher." Students in other scientific fields might find an interest in establishing their own lists. Every quarter of scientific endeavor can now assemble a formidable array of champions, for one need only look at the vast achievement in the sciences from A to Z.

How teachers will fit these commemorations into their teaching is left to them. The devices are endless. Students need this history and this humanism, and I believe teachers do, too. We should all humble ourselves in the memories of these gallant soldiers of the intellect.

Sir Charles Wheatstone	Born Feb. 6, *1802*
John Henry Poynting	Born Sept. 9, *1852*
Adrien Marie Legendre	Born Sept. 18, *1752*
Sir William Ramsay	Born Oct. 2, *1852*
Otto von Guericke	Born Nov. 20, *1602*
Antoine Henri Becquerel	Born Dec. 15, *1852*
A. A. Michelson	Born Dec. 19, *1852*

As I have suggested, there are numerous ways in which the teacher and the class can devote a lesson or two to the man and his work. A brief biographical sketch might be presented by a student whose interest lies in this quarter; an historical "play" might be staged in which the original experiments are reenacted. Indeed, a real moving drama could be presented—for these achievements are wonderfully dramatic. However it is done we are agreed on one thing: that the man and his work deserve to be recalled.

He is the richest who is content with the least.—Socrates.

GENERAL SCIENCE PREREQUISITES FOR HIGH SCHOOL CHEMISTRY*

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The Chemistry program was conceived, set-up and organized as part of a college preparatory school program—as preparation for the study of a "pure" science. This was well and good; it served a very valuable purpose. But today people are thinking of a high school program in terms of all the children of all the people; set up in terms of the ability, development and need of the individual and his social order.

In an ideal situation the prerequisites for Chemistry in the high school would simply be the correspondence of the directions of student developmental growth through his earlier years of training and, specifically, in General Science with the same patterns of objectives in the Chemistry program.

Objectives are directions of growth. As the pupil progresses through the grades of the elementary school and on to the secondary levels of instruction, objectives should take on enlarged meanings and there should be an ever widening and developing pattern of relationships among them. Even at the completion of secondary education they will not have been fully attained, but growth toward their attainment should be constant.

In the early years of the elementary school the needs and interests of a child regarding some principle of science may, perhaps, be satisfied by the generalization of a few simple facts into a minor principle. The same principle encountered at a later level of maturity, and in a more complex setting, may require not only more facts but the understanding of a larger principle or generalization. At the same time the pupil may be called upon to use this principle in a new and unique situation which requires him to interpret the evidence, formulate an hypothesis, test it imaginatively, and act in accordance. Thus the emphasis on certain objectives may shift from level to level.

Reference to types of objectives for Science teaching should be most fruitful in guiding a selection of prerequisites:

MAJOR OBJECTIVES:

1. Growth in functional understanding of scientific facts that are part of children's environment
2. Growth in development and understanding of scientific concepts and principles that function in children's experiences and help to explain them
3. Growth in the use of basic skills involved in the location of scientific data,

* Presented to the General Science Section of the Central Association of Science and Mathematics Teachers at the Edgewater Beach Hotel, November 28, 1952.

such as purposeful and effective handling and use of materials, observations and measurements, reading, use of references, and other manipulative activities

4. Growth of ability in the use of the problem-solving skills involved in the scientific method
5. Growth in the assumption of such scientific attitudes as open-mindedness, intellectual honesty, suspended judgment, and respect for human dignity
6. Growth in the appreciation of the potentialities of science for the improvement of human welfare, and of the dangers to civilization of its misuse
7. Guidance in the development of interests in science

The process of interaction between science and society, between science teaching and the larger goals of education in a democracy, is one that is constantly going on. It is also reciprocal in that it operates in both directions. Growth toward the oejbctives of science instruction affects the learner's behavior in other situations, both in and out of school. At the same time his experiences and observations outside the science class have a real bearing and effect on his comprehension of attitudes toward, and his interest in science. Clearly, these objectives are not conceived in any narrow sense. They do not envisage science instruction as a restricted, compartmentalized discipline confined to any classroom or laboratory. The science teacher can make broad applications to significant areas of human experience.

The degree to which the programs in Chemistry and General Science follow the directions pointed out by these objectives determines the prerequisites a student must possess for Chemistry. If the programs in General Science and in Chemistry are regarded as only a framework which gives direction to growth and understanding, then the student need only have had the appropriate experiences for his age and maturation level. Where the objectives do not correspond, the prerequisites may be simply the basic skills.

Where does Chemistry stand?

Chemistry teachers have tended to look upon the organization as the important item *per se*, and have presented chemistry as something to be memorized. Like all other teachers, they are no doubt justly accused of failing to develop adequately a pupil awareness of the extent to which facts, principles and generalizations of chemistry relate to every day living. With all science teachers the distinction frequently made between "pure" science and "applied" science has persisted all too long, and has tended to retard, if not prevent, the improvement of science teaching. Yesterday's pure science is today's applied science. It is doubtful whether the arbitrary distinction serves any useful purpose at the high school level, or even in college at the undergraduate level. It is, perhaps, serviceable at the post-graduate college level and in industrial research, where the frontiers of knowledge are being assaulted.

Science teachers have enjoyed two advantages to a degree not shared by teachers of other subjects:

1. concrete, objective materials available for demonstration and laboratory experiments in impressive profusion; and
2. almost daily dramatic developments in science which arouse universal interest and capture the imagination.

The applications, the consequences of scientific knowledge, pervade our daily lives and activities. We are, so to speak, steeped in an ocean of technology. The implications of scientific advance in the realms of politics, economics, social organization, and international responsibility are of such moment that one has every expectation of observing an awareness of these implications not only in the courses of study, but in classroom practice. To put it bluntly, there is little or no such awareness evident in science classrooms.

Many people fail to do any critical thinking. There is a tendency for people to accept what they read in the paper or what some one tells them without doing any thinking whatsoever. This is also true in some of our important social problems. People just fail to think critically about issues on election day. They let their alliance to a political party control their behavior without thinking the problem through. People need to learn to apply some of the scientific methods to everyday problems.

The process of developing understanding with respect to scientific facts, concepts, and principles is essentially the same as that of developing growth in certain habits of thinking, in attitudes and appreciations. The latter habits are those relating to problem solving by scientific method. Efforts at making the chemistry course a course in problem solving have not been very productive. Familiar quotations from writings of outstanding leaders in education, such as John Dewey, to the effect that the heart of science is its method can be found in the prefaces of textbooks and in other equally accessible places. That teachers have read these statements is evidenced by the fact that they practically always rate the teaching of scientific method high on their lists of objectives. But when asked what they do in their courses to further this end, teachers are likely to be "on the spot."

All science courses, general or special, pure or applied, embrace the concept of the scientific method; in varying amounts and emphasis to be sure. No one any longer speaks of the scientific method as if it were an invariable series of steps to be pursued to achieve a desired outcome. There are scientific methods, which have ingredients in common, but which are varied in terms of conditions of the problem and the ingenuity of the investigator. Such common procedures as observation, accurate measurement, recording, forming a hypothesis,

testing the hypothesis, drawing conclusions, repeating the performance as a checking device, fitting the results into the framework of known facts—these by no means embrace the whole method. There is an important ingredient to be found in *attitude;* or open-mindedness; or willingness to be proved wrong, and to reject a conclusion. The ability to apprehend relationships is as important an outcome as the factual knowledge.

There has been a variety of approaches advanced as a means of achieving knowledge of scientific methods: historical, expository, experimental. Science courses always embrace the last of these in their emphasis on demonstration and individual laboratory work. Unfortunately, in a preoccupation with manipulation and observation,—witness the elaborate laboratories and expensive equipment—the complete outcomes, both in scientific knowledge and in scientific methods have not always been realized. Much of the laboratory work, far from contributing to an approach to problem-solving and, to method, is of the cookbook variety; imposing a set procedure, a prescribed series of operations, the recording of observations (many of which either are copies from the book, or may even not be so), and drawing a conclusion known "without reference to the experiment."

It is not inconceivable that a smaller number of laboratory experiments may be devised, which serve to illustrate, a ply and instruct in scientific methods, so that knowledge of principles and an understanding of methods are both achieved. Then laboratory experience will take on new meanings, and additional dimensions. Individual and group projects, discussion surveys, interviews, library research, orthodox laboratory techniques, may all be contributions to laboratory experience.

Another problem extremely difficult to analyze for specific causes pertains to the lapsing of sustained pupil interests in further science study beyond the freshman school year. It is merely a conjecture, that some science teachers fail properly to motivate and build up a proper student frame of mind for further science study so that he will elect later or additional science courses on the basis of aroused interests? Is it not one of the important aspects of science teaching to point out to the students the importance of acquiring scientific knowledge as a prerequisite to understanding the scientific developments of a technological and atomic era together with the many vocational opportunities and social and political implications and ramifications that accompany these trends? Is it not the duty of teachers to encourage students to elect more science to acquire the theoretical technical preparation, and manual skills essential in meeting vocational requirements and improving living standards? Should we not point out the various vocational avenues open to students having a

background of scientific training; viz.: a knowledge and training in scientific principles and skills?

The report by Philip G. Johnson, Specialist for Science Division of Elementary and Secondary Schools of U. S. Dept. of Educ. in an inquiry into offerings, enrollments, and selected teaching conditions, 1947–48, "The Teaching of Science in Public High Schools," Bulletin #1950, No. 9, Federal Security Agency, Office of Education substantiates the following facts based on the returns of 715 high schools, 94.7% of the 755 schools in the sample selected randomly and proportionately as to the types and sizes of these high schools from 23,947 high schools in the U. S.

1. 60% of the pupils in the 9th Grade were enrolled in General Science.
2. Less than half of the senior high schools offered Chemistry and less than half offered physics. The combined enrollment in Chemistry and physics was equivalent to about one-third of the pupils in the 11th and 12th years.
3. Part-time science teachers outnumbered full-time science teachers.

Some studies have been made to bring to light specific factors that are responsible for maintaining sustained science interests. In appropriate settings, with specially trained teachers, and given proper opportunities, science interests of students can be increasingly stimulated. There is nothing that points to the fact that there is a special science talent *per se*. Experienced teachers recognize incipient science talent of students in their early high school careers. That there are some potent factors that affect sustained interest in science is not to be denied.

Mental ability tests seem to indicate that students most likely to follow and succeed in science are those who: 1. achieve high scores in the general intelligence factors; verbal meanings, mathematical concepts, and spatial relationships; 2. have trained, understanding teachers; 3. have opportunities to work in a scientific atmosphere; 4. show indications of success in science over and above the success in other intellectual or artistic endeavors.

The latent factor possibly responsible for science interest is perhaps a potential science talent factor, since early science interests are not always maintained in maturation to the same degree.

The material presented thus far, would seem to be an indictment of the science teacher. On the contrary, science teachers are deserving of high praise for the success of their efforts, considering the limitations under which they operate.

An examination of the literature of science education over the past few years reveals an ever-increasing number of titles pertaining to research or to general discussion bearing on the problem-solving objective. These articles range from attempts to analyse the specific elements of problem-solving behavior to experimentation in method-

ology related to the development of the skills. However, this objective has, for a long time, been merely taken for granted.

Many courses of study in science and many textbooks published within the last thirty years have listed problem-solving as an objective. Many authors of textbooks have given lip service to the objectives and then assumed that association with a course in science, a teacher trained in science, and scientific equipment and materials, would in some mysterious way, result in growth toward the objective. If the researchers in science education and the authors of textbooks fail to offer appropriate learning experiences, the teachers' difficulties will be almost insurmountable.

The National Science Teachers Association have provided, in their 1947–48 Bulletin, a definition of the "reasonable" atmosphere and work week conducive to good science teaching:

Science educators have long supported the thesis that many of the major objectives of high school science teaching can be attained only thru the efficient utilization of the laboratory method of instruction. (NSTA has consistently decried the tendency toward reducing the *time allotment* for laboratory teaching.)

Time and effort are required to make laboratory materials available and ready at the particular time when their use will contribute most effectively to the attainment of these objectives.

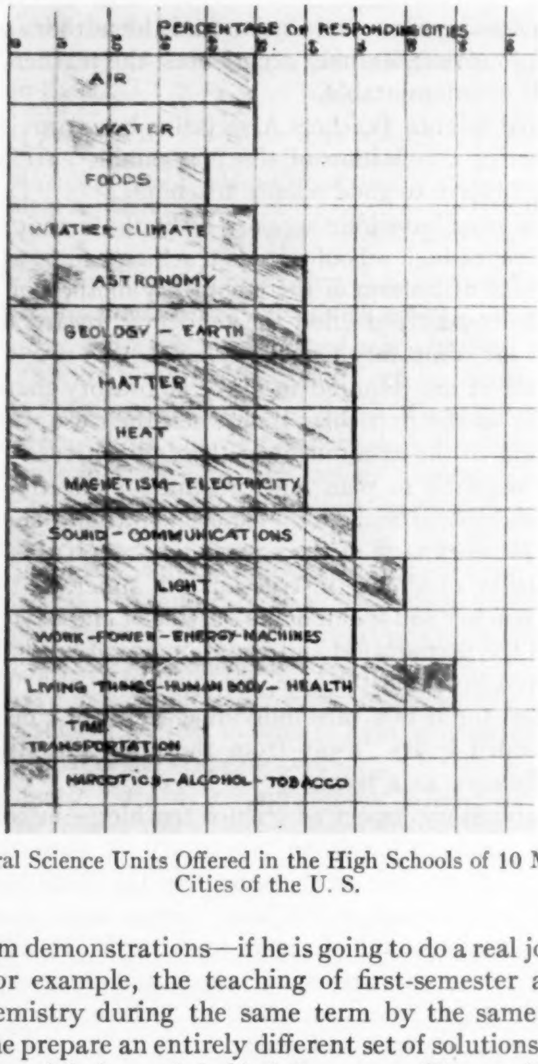
The *Time* required to plan and prepare for effective laboratory work—both individual and group experimentation—should be provided *within the work week* of the science teacher. If this is not done, either the quality of science instruction will suffer, or the conscientious science teacher will spend hours outside of and beyond a normal work week in the preparation and maintenance of needed laboratory materials. Even in the latter case, the quality of instruction is still likely to suffer, for it is a rare individual who can consistently rob himself of needed hours "away from the job" and still retain his maximum efficiency as a teacher.

It is the laboratory aspect of science teaching—in common with certain other subjects involving laboratory or shop work—which places upon the instructor much more than the usual burden of duties associated with classroom teaching. Science teachers usually have almost the normal amount of paper work to do. In addition, they not only have to prepare, use, repair, clean, and put away laboratory equipment, they also have around 40 to 50 laboratory "write-ups" per pupil per year to check and mark.

The learning of "science"—science as content, methods, and attitudes—involves *activity* on the part of the learner. Learning activities in science require specially-equipped rooms and special materials

and apparatus. Real learning in science cannot be achieved by "chalk-talk" methods or simply by reading and "reciting back" the textbook. It is well to say that ingenious science teachers can do much with very little equipment. We submit as fact, however, they cannot do *enough*.

Every different preparation required of the science teacher calls for a corresponding and different sequence of laboratory preparations



General Science Units Offered in the High Schools of 10 Major Cities of the U. S.

and classroom demonstrations—if he is going to do a real job of science teaching. For example, the teaching of first-semester and second-semester chemistry during the same term by the same teacher requires that he prepare an entirely different set of solutions, apparatus, and other materials for each half of the course. We consider 2 preparations in science to be the optimum or "reasonable" teaching load; 3 preparations are considered unreasonably burdensome. The com-

mittee holds that it is impossible to do *good* science teaching with 4 or more preparations.

Provision of laboratory assistance in every high school is a recommendation of practicing science teachers. It is looked upon almost as a necessity if real laboratory teaching is to be done in situations where the teaching load reaches 3 or more preparations.

Opinions expressed in these studies hold that a maximum class size of 25 should be our goal (in all laboratory sciences), and that every science class should be held rigidly below 30.

These studies strongly support the thesis that where laboratory assistants are not available, the science teacher should be freed of extra-teaching duties to the extent required to provide sufficient time for laboratory teaching *within* a "reasonable" work day and work week.

From a representative sample consisting of ten percent of the science teachers in the State of New York, in all types of schools and communities, the following data were indicated to be characteristic of actual conditions:

a. Teacher load analyzed from the point of view of number of preparations revealed that a *majority of the programs (53%) required three and four preparations.*

b. The *average* class size reported was about 30. To reach this average many had to exceed 30. More than 25 tends toward a rigid, verbalistic and text-book centered curriculum.

c. Science teachers are generally assigned non-teaching responsibilities of a technical nature without commensurate allowance in time or compensation.

d. Nearly half of the teachers reporting indicated inadequacies in science room furnishings, experimental equipment, or textbooks. Ninth year General Science classes are generally taught in rooms without gas, water, or suitable electrical connections. About fifty percent of the teachers reported obstacles to individual laboratory work. In addition, 140 of 313 teachers had *no laboratory work at all*!

e. Opportunities for professional growth were reported as inadequate or lacking in a majority of places. Two-thirds are dissatisfied with the kind or amount of guidance and supervision they receive. Half the teachers reporting it as lacking or a hindrance.

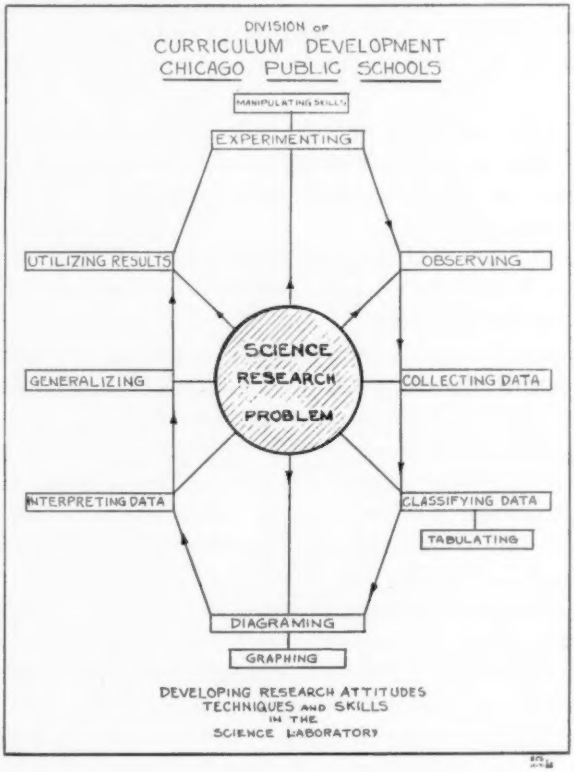
In the same NSTA report, Earl R. Glenn summarizes the responses of 217 teachers of science from large high schools in 38 states and finds that:

a. time simply is not allowed within the school day for the efficient preparation for experimental science instruction.

b. Regarding the number of different school grades represented in the science teachers' classes, about 11% reported only 1 grade, 32%

reported 2 grades in their classroom, 36% found 3 grades, while 20% report 4 school grades in a single class. Where is the continuity of growth?

Studies by Schwachtgen of the division of curriculum development, Chicago Public Schools, 1952, show that there are fifteen units common to the General Science programs of 10 major cities. There are usually two to five additional units prescribed in the course of study. These 17 to 20 units are studied over a period of 36 to 40 weeks or about one unit every two weeks. Each two weeks of school contains ten school days of approximately 40 minutes each.



Allowing one day for examination, one-half day for reviewing and evaluating the examination, one day for audio-visual presentation, (and an occasional holiday) one or two minutes from each period for checking attendance, and some minutes devoted to that small minority who resist any, and all motivation, the teacher faces the task of teaching thirty students the intricacies of one complete unit in seven scant periods. The task of conforming to their needs for developmental growth along the directions indicated by the objectives is a monumental one.

It may be said in conclusion that science courses in our high schools have a tendency to lag behind the scientific trends of an ever-changing world, nor have they met the demands of general education for terminal courses that fulfill the needs of the vast majority for whom high school is terminal education. Under these circumstances the prerequisites for Chemistry consist of the basic reading skills, an interest in science, and the ability to follow directions.

PREMISES

1. The philosophy underlying the entire science program should be in harmony with the objectives of the total program of education.
2. The selection of science experiences and learning should be governed by the degree to which they help pupils participate effectively in every day personal and social living.
3. The approach to science education should be experimental and stem from pupil experiences. These should be both the natural and spontaneous or the planned controlled kind and thus related to the needs and interests of the child and society.
4. A resource unit approach wherein large problems of interest to children and broken into purposeful units and problems giving direction to learning that will assist in providing a basic integrated program and philosophy.
5. Beyond the common core of science experiences, provisions for adaptations to differences in classes, schools, communities, vocational interests and capacities of pupils should be made.
6. Science experiences and learning should also take into account other curriculum areas such as social studies, health, home economics, gardening, conservation of resources.
7. Requisite materials of instruction and equipment for efficient science instruction should be available at all stages of development and implementation of the science program.
8. In-service training of teachers and supervisors should proceed in connection with both the developmental and implementation of the science program at divisional levels.
9. Close co-operation of college science agencies to provide the requisite in-service training in connection with the science program should be specifically planned.
10. Appropriate course requirements in science for teaching and supervisory licenses should be instituted to enhance the teaching of science.
11. A framework for the evaluation should be set up at the very outset of the curriculum development program. Its scope should include objectives, materials and equipment, teacher training, and pupil progress.
12. Science evaluation should be a continuous matter with immediate and long time needs in view. Well-designed and evaluated pilot situations should precede large-scale operations. Evaluation techniques for less tangible but equally important outcomes should be studied, developed and used.
13. The science division of the curriculum should maintain close liaison with the science industries and recognize the continued need for scientists.

Bibliography

Laton, Anita D. and Powers, Samuel R. *New Directions in Science Teaching.* New York: McGraw-Hill Book Company, Inc., 1949.

Hoff, Arthur G. *Secondary-school Science Teaching.* Philadelphia; The Blakiston Company, 1949.

Taylor, F. Sherwood. *The World of Science.* New York: W. W. Norton, 1950.

TAYLOR F. SHERWOOD. *A Short History of Science and Scientific Thought.* New York: W. W. Norton, 1950.
CONANT, JAMES. *Science and Common Sense.* New Haven: Yale University Press, 1951.
WOODRING, OAKES, BROWN. *Enriched Teaching of Science in the High School.* New York: Bureau of Publications, Columbia University, 1941.
The 46th Yearbook of the National Society for the Study of Education. Chicago: University of Chicago Press, 1947.
The Thirty-first Yearbook, National Society for the Study of Education. Chicago: University of Chicago Press, 1932.
Science Teaching Today, National Science Teachers Association. Washington, D. C. 75¢ Copy, 1950.
Commission on Secondary School Curriculum, "Science in General Education," Progressive Educational Association. New York: D. Appleton-Century Company, 1938.
The Teaching of Science in Public High Schools. Washington, C. D.: Federal Security Agency, Office of Education, 1950.
Atomic Energy and the Life Sciences. U. S. Government Printing Office.

BABY BRAZILIAN OTTER NOW IN NATIONAL ZOO

Probably the most travelled otter in the world has now settled down, at least temporarily, in his new home at the National Zoological Park here.

Less than two months ago, this baby giant Brazilian otter, or ariranha, the first ever brought to America and perhaps the first ever kept alive in captivity, was happily playing with his two brothers in the Aquidauana river, in the heart of the Gran Chaco of Brazil.

Two animal collectors, one the famous bearded hunter of jaguars, Sascha Siemel, and Wyman Carroll, his young partner, were hidden near the river, watching them. When the mother carried the cubs into a hollowed-out den along the bank, Siemel and Carroll quickly blockaded the entrance and began to dig into the earth some 15 feet away.

When they had dug down into the main chamber, they tossed a lasso over the mother. The loop fell around her broad, flat tail. In a flash she jumped from the den and broke loose, abandoning the three cubs.

Siemel and Carroll pulled out the litter, caged them, and began the long trek back to civilization. The first leg of the journey with the squealing captives was by dugout canoe. Then the voyage was continued by ox cart, truck and train successively. The runt of the litter died soon after the capture, but the two survivors thrived on a diet of sugared cow's milk and oatmeal during this phase of the trip.

An Aerovias de Brasil plane then flew the baby giant otters to Miami. But even the temperature of wintertime Miami was too cold for the tropical animals, and one of them died there of a cold.

The remaining cub, which Siemel named Ike because it was captured on election day, arrived safely in Washington by air, and has been installed in its new, warm quarters in the national zoo.

Siemel and Carroll, who flew with the otter to the United States, said Ike was about four months old at the most, It is already nearly as big as an adult North American otter. When fully grown, the giant Brazilian otter may measure six feet in length.

The animal collectors also brought three jaguar cubs back with them. Siemel said he had to kill the mothers to capture the cubs. The usual way the bronzed, 63-year-old man kills jaguars is by stopping their deadly charge with a spear.

Known as the "tiger man" because of his fame as a hunter, Siemel has spent 40 years in Brazil.

USING TELEVISION IN ELEMENTARY SCIENCE CLASSES

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Recently the Federal Communications Commission authorized 242 channels in the present VHF bands and the newer UHF bands for educational purposes. State educational authorities and universities are working on plans for constructing and operating these stations. It may be a little time before these stations are in actual operation and on the air. There are, however, some opportunities for science teachers to utilize the limited number of science telecasts now being offered by commercial stations. True, there are but a few good educational telecasts available at present, but the success of the educational TV channels will depend on good station programming and *utilization* by the teachers in the classroom and for after-school-viewing. Of the approximately 1300 hours the seven stations in Metropolitan New York are on the air in a week, only 35 to 40 hours are given to educational programs. This is far below what was expected of the commercial broadcaster's television code.

It is possible to assign televiewing to students for homework. Students frequently go to each others home's to do homework and view TV. In many areas the number of sets ranges between 75 and 88 percent of the homes. It should not be too difficult for the teacher to make a schedule for all students and himself to see certain programs.

There are some excellent network programs televised each week that can aid and benefit science units. The "*Johns Hopkins Science Review*" as televised over the Dumont network on Monday evenings can be of value to the upper grades and junior high school class. Much of the newer materials not found in textbooks has been presented. The materials and concepts shown can be followed by discussion in class the next day.

"Zoo Parade" televised over the National Network on Sunday afternoons is especially helpful in presenting the various animals studied in the intermediate grades. Trips to the zoo are helpful, but many cities don't have them, and smaller communities can also see many animals studied. While the program is best suited for the intermediate grades, upper grades and high school biology classes can benefit from the Chicago Lincoln Park zoo telecast.

Dr. Roy K. Marshall's "*The Nature of Things*" has received many citations for his simple explanation of many difficult concepts and ideas. He has presented units on astronomy, atomic energy, light, sound, heat, electricity, magnetism, rocks and plant development.

All are topics studied in the upper elementary grades. The experiments and simple demonstrations can be repeated in class by students and teacher.

In-school viewing of science programs has also been developed by cities cooperating with local TV stations. We have been fortunate to have been able to view the efforts of both New York City and Newark in this area. "*Science Lesson*" was televised in the Metropoloian New York area over WATV, Newark. It was designed to go with the Newark elementary school science course of study, but where our units overlapped, we used the program. It is possible for the resources of a large city school system to be seen by all schools in the area. Thus we saw miniature planetariums, telescopes, collections of rocks, animals and plants that are rarely found in the individual class on the elementary level.

New York City has presented a series called "*Science At Your Fingertips*" over WPIX. This program was designed for the upper elementary and junior high school. Advanced classes viewed this program as part of their elementary class work. Eighth grade students have found it helpful, and teachers also value the in-service type of training they get from the demonstrations.

Philadelphia also presents "*Science Is Fun*," which is designed for the intermediate grades. Here valuable information and material can help the elementary teacher with science units. The program can be seen in lower Pennsylvania, southern New Jersey and Delaware.

Weather reports are televised daily by most stations. These can be of great help to the classroom teacher when the topic of weather is studied. The programs not only discuss the local weather conditions, but also show the national weather picture, with temperature and air pressure conditions over the country.

Television is going to play an increasingly important roll in education. The success of the new educational TV stations depends on two items: namely, good programs from the stations and use of the programs by teachers. If teachers fail to take advantage of present offerings, TV will be like radio. Wrestling, silly comics and westerns will dominate. Little on radio is of value. Television is the greatest medium of communications developed. Teachers can gain much experience in using present offerings that are of value in science education. Developing utilization procedures and evaluation techniques now will be of utmost importance when educational stations are on the air.

The more we do, the more we can do; the more busy we are, the more leisure we have.—Hazlitt.

TEACHERS' MARKS AND THE FLUCTUATIONS OF SAMPLING

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A student's plane geometry examination paper was reproduced and copies of it sent to 114 high school mathematics teachers. They were asked to mark these copies. Their marks ranged from 28% to 92%.[1] This and many similar experiments show the wide variation existing in teachers' standards of marking. To remedy this situation the educationists proposed the so-called Missouri plan of marking, or what our students call "grading on the curve." According to this plan, it is assumed that a certain per cent of the population of all students are A students, a certain per cent are B students, etc. Further, it is assumed that any class constitutes a random and unbiased sample from the population of all students. Any per cents for the numbers of marks may be assumed. The per cents for A, B, C, D, E, respectively, that are sometimes used are 5, 20, 50, 20, 5. In a class of 20 students we would then expect 1 A, 4 B's, 10 C's, 4 D's, and 1 E (E meaning failure). These are the theoretical or expected numbers of each mark. But they are subject to what are called fluctuations of sampling. It is like the situation when a coin is thrown 100 times. The expected or theoretical number of heads is 50, but we are not very likely to obtain it if we perform the experiment. A deviation from 50 heads in the 100 throws is called a fluctuation of sampling. The question naturally arises, how large a deviation may we have before we suspect a biased coin? There is no unequivocal answer to this question. It is possible to obtain no heads or 100 heads even with an unbiased coin. However, such results would be very improbable and would lead us to strongly suspect bias. A similar question arises with respect to marks. How large a deviation from the expected numbers 1, 4, 10, 4, 1 for A, B, C, D, and E, respectively, can we have without suspecting that the instructor's marking is biased, i.e., too hard or too easy? Let us try to obtain a possible answer to this question.

In our class of 20 students, the probability of registering an A student is 1/20, and the probability of registering a non-A student is 19/20. Then the probabilities of no A students, 1 A student, 2 A students, 3 A students, etc., are given by the successive terms of the binomial expansion of

$$(19/20+1/20)^{20}.$$

[1] See Starch: *Educational Psychology*, Macmillan, 1920, page 433.

We add the terms of this expansion from each end until we have two sums each just under 0.01. We assume that the numbers of A students corresponding to the probabilities in these two sums are very unlikely as fluctuations of sampling. In other words, these numbers of A's indicate probable standards on the part of the teacher at variance with the assumed student population. They indicate that the teacher's marking is probably too hard or too easy. Thus we find that we may have as few as no A's and as many as 3 due to chance, or the fluctuation of sampling. Of course, the number 0.01 is purely arbitrary, but it is commonly used for this purpose. Any other small proper fraction could be used. When the other marks are treated like the A's, we obtain the following table.

(1) Grade	(2) Range	(3) Poor Class	(4) Bright Class	(5) Expected
A	0 to 3	0	3	1
B	0 to 7	0	7	4
C	5 to 16	10	10	10
D	0 to 7	7	0	4
E	0 to 3	3	0	1

If, in a poor class, an instructor should assign the maximum numbers of D's and E's and minimum numbers of A's and B's with the rest of the grades C's, he would obtain column (3). His deviation from the expected distribution in column (5) would be explainable as a fluctuation of sampling under our hypotheses. In a bright class the order of frequencies might be reversed as in column (4). Of course, the foregoing example is merely illustrative. Any percentages of A's, B's, C's, etc. could be assumed and discussed with respect to a class of any size in a similar manner. It seems to be the opinion of educationists that the percentages should be chosen in conformity with the needs and environments of the institution.

We might inquire about the probability of obtaining the expected distribution in column (5). This is given by

$$\frac{20!}{(4!)^2 10!}\left(\frac{1}{20}\right)^2\left(\frac{1}{5}\right)^8\left(\frac{1}{2}\right)^{10}=0.00727.$$

Suppose a teacher started in his profession at 25 and retired at 65. If he taught 10 classes of 20 students each per year, the expected number of such classes with the distribution of marks in column (5) would be

$$400\times 0.00727=2.91=3 \text{ approximately}.$$

But this expected number would also be subject to the fluctationus of sampling so that, in his whole career, he might never have the expected distribution in column (5). This is a fact that might well be appreciated by school administrators who want their teachers to use the Missouri plan of marking.

A STATEMENT

By the Cooperative Committee on the Teaching of Science and Mathematics of the American Association for the Advancement of Science

One hundred teaching scientists and mathematicians from all parts of the country met at the U. S. Office of Education on November 13, 14 and 15, 1952, to consider the problem of identifying and providing for the educational needs of students with high aptitude in science and mathematics. A year ago a similar conference emphasized the importance of secondary schools in supplying the need of personnel trained in science and mathematics. Since then, the Office of Defense Mobilization and reports from industries again call attention to the continuing and increasing lack of such personnel.

It is, therefore, the sense of this conference

1. That the proper development of such personnel is essential to the welfare of the nation; especially so, in view of the critical shortage of scientists and engineers, the present and anticipated demands of a technological age and the state of international tension.
2. That equality of educational opportunity is basic to democracy; and that that implies an opportunity for every individual to attain his own maximum achievement.
3. That we can not afford to continue the resulting loss to society in high quality human resources and creative contributions.
4. That current general practices for identifying and developing students with high aptitude in science and mathematics are inadequate.
5. That many tested and successful practices *are* being used for the early identification and proper development of students with high aptitude. Those practices should be made widely known.
6. That schools and colleges be urged to modify administration, curricula, guidance and teaching facilities and procedures so as to facilitate the widespread use of these successful practices.
7. That inadequate educational provisions for youth of high promise cause difficulties in coordinating school and college education.
8. That teacher training institutions and school systems give greater recognition to the need for teachers qualified to teach students of top-level ability.

Donald W. Lentz, Representative
Central Association of Science and
Mathematics Teachers
6726 Ridge Road
Parma 29, Ohio

Traffic-light spotter for automobiles is made of a clear plastic molded into a rainbow shape. Acting as a lens, the device is attached to the windshield molding of a car. It reflects the image of the traffic light to the driver, even when a sun visor blocks his view directly.

Every man has in himself a continent of undiscovered character. Happy is he who acts the Columbus to his own soul!—Stephen.

THE ELEMENTARY SCHOOL SCIENCE LIBRARY FOR 1951–1952

Paul E. Kambly
School of Education, University of Oregon, Eugene, Oregon

This is the ninth yearly list of reference books for elementary school science compiled and published in School Science and Mathematics. The purpose, like that of preceding lists, is to suggest to elementary school teachers, books that are supplementary to basic text series either for their values as sources of information or for recreational reading. The sub-division topics are of no significance except as an aid in grouping the references.

The grade levels indicated are the lowest in which it is recommended that the books be used. Exact grade placement is difficult because of variations in pupil reading ability as well as differences in how the books are used. The recommendations and the brief annotations are based on an examination of each book listed.

Reference Books for Elementary School Science

Animals

(See also list of books on birds and insects)

	Grade	*Price*
Alligators and Crocodiles. By Herbert S. Zim. 64 pp. '52. Morrow. This is the eleventh book in a series by the same author. It is well written and well illustrated. Children of all ages will enjoy reading this book.	3	$2.00
The More the Merrier. By Fleming Crew. 121 pp. '52. Oxford.... This book should be read to children. There are eight different animal stories. Many teachers would object to the personification of animals in each of these stories.	1	2.75
Spike—The Story of a Whitetail Deer. By Robert M. McClung. 64 pp. '52. Morrow.................................... This is the story of the first year of a buck deer's life. It is interestingly written and has numerous illustrations.	3	2.00
The Wonder World of Animals. By Marie Neurath. 36 pp. '52. Lothrop.. This is primarily a book of pictures showing many interesting facts about different animals. Children can read the text material.	3	1.50
Wild Folk in the Woods. By Carroll Lane Fenton. 128 pp. '52. Day.. This book describes 36 different kinds of animals common to various parts of the United States. The author is also the illustrator. His drawings are accurate and the text descriptions are clearly written.	4	2.50
The First Book of Snakes. By John Hoke. 69 pp. '52. Watts...... This book describes most of the common snakes. It is well illustrated and the drawings would be interesting to children who can not read the text.	5	1.75
What Dog Is It? By Anna Pistorius. 25 pp. '51. Wilcox....... This book includes good color illustrations of 40 different types	5	2.25

	Grade	*Price*
of dogs. Even children who can not read the text will enjoy looking at the pictures.		
What Horse Is It? By Anna Pistorius. 25 pp. '52. Wilcox......	5	2.25
This book has colored pictures of horses from the Dawn Horse to a large Shire Horse. Each page answers one question about horses.		

Birds

Birds. By Herbert S. Zim and Ira N. Gabrielson. 157 pp. '49. Simon..................	4	1.50
One of an excellent series of pocket size guide books. There are 112 birds in full color with accurate text. Small maps show where the birds live during summer and winter seasons.		
Birds and Their Nests. By Olive L. Earle. 64 pp. '52. Morrow....	5	2.00
Forty-two varieties of birds are included in this book. The text and drawings describe the nests, eggs, and adult birds. This is an excellent reference book for any region in the United States.		
The First Book of Birds. By Margaret Williamson. 69 pp. '51. Watts..................	5	1.75
This is a good beginner's book on birds. It includes descriptions of birds and their adaptations and the things they do as they live their lives. The illustrations are in both black and white and color.		

General Nature Study

In Yards and Gardens. By Margaret Waring Buck. 72 pp. '52. Abingdon..................	4	3.00
About 200 different kinds of living things are pictured and described in this book. All illustrations are black and white drawings. The text material has been checked for accuracy.		
Nature Was First. By Walter C. Fabell. 32 pp. '52. McKay....	4	2.00
This book shows how nature was first with ideas for shower baths, fishing lines, underwater goggles, air cooling, cow sheds, sails, snowshoes and similar items. The book is a useful elementary reference on adaptations.		
A Book of Nature. By Pelagie Doane. 110 pp. '52. Oxford........	6	4.00
This book has 24 full-color pages. It is divided into three major divisions: meadows, woods and sea.		

General Science

Who's Upside Down? By Crockett Johnson. 28 pp. '52. William R. Scott..................	3	1.75
This is an introduction to gravity that may be more humorous to an adult than an eight year old child. A kangaroo and its young carry on quite a discussion of "Who's Upside Down?" and decide that you are upside down.		
The First Book of Science Experiments. By Rose Wyler. 69 pp. '52. Watts..................	4	1.75
There are suggestions for experiments with air, water, plants, electricity, chemistry and light using only simple equipment.		
Lightning and Thunder. By Herbert S. Zim. 64 pp. '52. Morrow..	4	2.00
Both children and adults will enjoy the text and pictures which explain the phenomena of lightning and thunder. In any region where thunderstorms are common this book should be available to children.		
Rocks, Rivers and the Changing Earth. By Herman and Nina Schneider. 181 pp. '52. William R. Scott..................	4	3.00

	Grade	Price
This is a beginner's geology book that should be included in every elementary school library. There are numerous line drawings that help to explain the text.		
You Among the Stars. By Herman and Nina Schneider. 64 pp. '51. William R. Scott..........	4	2.75
This is a beginner's book of astronomy. It is clearly written, well illustrated and answers many common questions about the universe.		
The First Book of Water. By Jo and Ernest Norling. 45 pp. '52. Watts..........	5	1.75
This is a good reference for almost any group of children who wish to learn more about water and how it affects their lives. It includes a variety of information from the composition of water to how a pump works.		
It's Fun to Know Why. By Julius Schwartz. 125 pp. '52. Whittlesey..........	5	2.25
This book describes many easy experiments with common materials such as iron, coal, cement, glass, rubber, wool, salt, bread, soap and paper.		
Let's Look at the Sky. By Marie Neurath. 36 pp. '52. Lothrop.....	5	1.50
This is a picture book that may serve as an interesting introduction to a study of the sky. It deserves a place in any collection of children's books on astronomy.		
Sound—An Experiment Book. By Marian E. Baer. 127 pp. '52. Holiday..........	5	2.50
Sound is explained in a series of rather simple experiments that lead to an understanding of conduction, velocity, echoes, frequency, pitch, tone and similar phenomena.		
Your Telephone and How It Works. Herman and Nina Schneider. 96 pp. '52. Whittlesey..........	5	2.00
This is an excellent explanation of how a telephone works. The text and diagrams describe how sound is transmitted, how dial phones work and how ship-to-shore and train telephones work.		
Atomic Experiments for Boys. By Raymond F. Yates. 132 pp. '52. Harper..........	6	2.50
This is an explanation of the principles of atomic energy. It includes the story of the discovery of the electron, the proton, the neutron as well as the invention of the cyclotron.		
Television—The Magic Window. By Frank Denman. 60 pp. '52. Macmillan..........	6	2.00
This book traces the development of television and explains how a set works. It is not an easy reference but could be used by some pupils.		
Insects		
The First Book of Bees. By Albert B. Tibbets. 69 pp. '52. Watts..	4	1.75
This book explains the organized society within a beehive. In addition to the story of honeybees it includes beekeepers and how they care for their hives.		
Honeybee. By Mary Adrian. 51 pp. '52. Holiday..........	4	2.00
This is a book that would be especially useful in classrooms that have demonstration hives. It is attractively illustrated and should be well liked by children.		
Insects. By Herbert S. Zim and Clarence Cottam. 157 pp. '51. Simon..........	4	1.50
One of an excellent series of pocket size guide books. There are 225 species described and pictured in full color. Small maps of		

	Grade	Price
the United States show the distribution of each species.		
Manty, the Mantis. By Captain Burr Leyson. 63 pp. '52. Dutton.	4	2.50
The story of a Mantis from hatching time through a summer season. The numerous full page pictures are excellent.		

Physiology

	Grade	Price
All About Eggs and How They Change into Animals. By Millicent Selsam. 64 pp. '52. William R. Scott	3	2.00
This is a book about the way life begins. It includes a discussion of mammal eggs along with pictures showing how eggs develop into organisms.		
What's Inside of Me? By Herbert S. Zim. 32 pp. '52. Morrow	3	1.75
This is a well-illustrated book that explains in simple terms how we digest food, what bones are for, how the heart works and other things about the human body. Certain pages of small-type are intended to be read aloud by an adult while a child looks at the pictures.		
The Story of Microbes. By Albert Schatz and Sarah R. Riedman. 172 pp. '52. Harper	6	2.75
The following questions are some of those answered. What are the different kinds of microbes? Why are they so important to us? When are they dangerous? How do they multiply? Where do they live? Who first discovered them?		

Plants

	Grade	Price
What's Inside of Plants? By Herbert S. Zim. 32 pp. '52. Morrow.	3	1.75
This book has some pages that can be read by children and others that an adult reads aloud while a child looks at the pictures. It is an excellent introduction to the parts of a plant.		
Flowers. By Herbert S. Zim and Alexander C. Martin. 157 pp. '50. Simon	4	1.50
One of an excellent series of pocket size guide books. There are 134 color illustrations with text and maps showing the range of each species.		
Thanks to Trees. By Irma E. Webber. 60 pp. '52. William R. Scott	4	2.00
This book emphasizes the inter-dependence of trees, loyer animals and people. It is an excellent beginners reference on problems of conservation.		
Trees. By Herbert S. Zim and Alexander C. Martin. 157 pp. '52. Simon	4	1.50
One of an excellent series of pocket size guide books. There are colored pictures of 130 different trees with related text material. The range for each tree is shown on a small map of the United States.		
Play With Leaves and Flowers. By Millicent E. Selsam. 64 pp. '52. Morrow	5	2.00
This book is primarily about plant movements and what causes them. It answers questions such as: What causes clover leaves to fold up at night?, What makes it possible for the seed pods of the touch-me-not to fly open with a snap? and Why does a sunflower plant follow the movement of the sun from east to west?		

Transportation

	Grade	Price
The First Book of Trucks. By Campbell Tatham. 45 pp. '52. Watts	4	1.75

	Grade	Price
This is a good book about types of trucks and the part they play in our lives.		
Rockets and Jets. By Marie Neurath. 36 pp. '52. Lothrop......	4	1.50
A brief, accurately written and well-illustrated book that answers these questions: How do rockets and jets work? Why can a rocket go higher than a jet plane? Why do some planes use a propeller as well as a jet? Will there ever be jet ships and jet cars? How might the space ship of the future be driven?		
The First Book of Airplanes. By Jeanne Bendick. 69 pp. '52. Watts..	5	1.75
This is a well-written book which describes types of airplanes and how they are used. There is considerable emphasis on the types of flying jobs for people.		
The Boys' Book of Model Railroading. By Raymond F. Yates. 172 pp. '51. Harper..................................	6	2.50
This book should be available to every boy who has an interest in model railroading. It would be especially useful where father and son work together because the text is too difficult for a typical sixth grade pupil.		
Model Jets and Rockets for Boys. By Raymond F. Yates. 108 pp. '52. Harper..	6	2.50
This book tells how to build jets and rockets. It is clearly illustrated and will interest any boy who wishes more information about high speed flying models. Most sixth grade pupils will need help with the text material.		

Publishers and Their Addresses

Abingdon: Abingdon-Cokesbury Press, 810 Broadway, Nashville 2, Tennessee.
Day: The John Day Company, 121 Sixth Avenue, New York 13, New York.
Dutton: E. P. Dutton and Company, Inc., 300 Fourth Avenue, New York 10, New York.
Harper: Harper and Brothers, 49 East 33rd Street, New York 16, New York.
Holiday: Holiday House, 8 West 13th Street, New York 11, New York.
Lothrop: Lothrop, Lee and Shepard Company, Inc., 419 Fourth Avenue, New York 16, New York.
McKay: David McKay Company, 225 Park Avenue, New York 17, New York.
Macmillan: The Macmillan Company, 60 Fifth Avenue, New York 11, New York.
Morrow: William Morrow and Company, 425 Fourth Avenue, New York 16, New York.
Oxford: Oxford University Press, 114 Fifth Avenue, New York 11, New York.
William R. Scott: William R. Scott, Inc., 8 West 13th Street, New York 11, New York.
Simon: Simon and Schuster, Inc., 630 Fifth Avenue, New York 20, New York.
Watts: Franklin Watts, Inc., 119 West 57th Street, New York 19, New York.
Whittlesey: McGraw-Hill Company, 330 West 42nd Street, New York 18, New York.
Wilcox: Wilcox and Follett Company, 1255 South Wabash Avenue, Chicago 5, Illinois.

Orchestral tape recordings soon are to be introduced commercially, featuring noted conductors and soloists. To be played back at 7.5 inches per second, the tapes will be divided into two tracks, each giving high-fidelity reproduction of musical tones of 50 to 15,000 cycles.

WHAT IS ELEMENTARY SCIENCE?*

EGGERT MEYER
Francis W. Parker School, Chicago, Ill.

Jessica, 4-year old member of the Junior Kindergarten, asked: "What makes a bus run?"; while John of the 2nd grade wants to know about space suits. Tom, a lively boy in the 4th grade, asks: "What are blue babies?", not to be outdone by Corky of the 6th, who is concerned about "flying saucers." The Jessicas, Johns, Toms, and Corkies have brothers and sisters, who watch the TV sets, see movies, read newspapers. They see the "Ding-Dong School" teacher grow a sweet potato, watch Mr. Wizzard do kitchen-sink experiments, hear the sounds of strange animals on the "Zoo-Parade." Their siblings read about Krebiozen, see Disney's "Nature's Half Acre" and are able to put us teachers to shame with their "expert" knowledge of jet planes of the latest design. Their older brothers have operated radar, while the 8th graders argue heatedly about interplanetary travel, radiation sickness and penicillin.

Thus Pat and Joe, now in the second grade, live in an exciting scientific world, in a bewildering technological age, which many of us teachers only begin to comprehend. They will in a few years, study, work and live in a world, which we, the educators, cannot yet envisage. To them, sonar, ultra-sonic travel, and radioactive carbon can be taken for granted. Shall we now abandon the ship of "our feathered friends," of "bees and butterflies," of "hibernation and migration" in favor of the ever so exciting space ship of the future? Shall we risk our time-tested safety of the well-organized curriculum and admit that textbooks or graded readers are apt to be obsolete, the day they are published?

Whatever we decide tentatively, of certain facts we may be sure: Pat, Joe, Tom and Jessica are American boys and girls. As such they have the right (unlike children in dictatorships) to free inquiry. They may say: "I'm from Missouri—you've got to show me"; or more patently: What is the evidence?

They and we are free from thought-control and thus participate in the process of "Lehrfreiheit und Lernfreiheit" e.g. freedom to teach and freedom to learn. Thus, while you and I as educators in the elementary school can hardly hope to anticipate all the problems confronting our youngsters in years to come—we may still help them to solve. How can this be done?

We may be able to help our children—on the basis of their needs and interests—to develop those tools, which are useful in attacking

* Presented at the Elementary School Group of the Central Association of Science and Mathematics Teachers at the Edgewater Beach Hotel, Chicago, November 29, 1952.

and solving new problems. We should therefore abandon the position of the omniscient, omnipotent teacher in favor of sharing their inquiries. We then become guides, interested participants, promoting scientific thinking, scientific attitudes, scientific procedures.

Do we say, in response to a question: "What do you think?" or "How could we find out?" Are we not apt to give a pat, encyclopedic answer? Is it not true, that too often we relegate the genuine interest-question to oblivion by saying "you're too young for this," "you'll get this later," "this has nothing to do with our present study?" Are we not too often using the above techniques to cover up for our own ignorance or lack of resourcefulness?

Corky, Tom and Jessica are curious, imaginative and perhaps worried. We might help them then, by developing simple tools to solve their problems. Such tools ought to make them independent of us, the teachers, to a degree. How do we find out?

By consulting scientifically reliable books and/or magazines.
By asking men or women who are experts in certain fields.
By observing on the spot, or by performing controlled experiments.
By thinking through, together, a problem, a question.

Note: They, the children are doing the "finding out," with a maximum of independence from the teacher. They, on their developmental level, are reaching tentative conclusions. Through habituation, they learn scientific procedures and thus wean themselves of the teacher.

Such a procedure implies several "sine qua nons." It assumes that the teacher is sufficiently secure to admit her own ignorance or fallibility. At the same time it means, that many reference books and magazines are available for children and teachers. It makes it mandatory, that the elementary teacher finds it exciting to tackle new problems *with* her children; that she herself constantly enrich her background via meeting interesting people and having new experiences. It means, that we keep our "course of study" fluid and reexamine it periodically. It finally means, that we listen "with the third ear" to detect and fathom the interests, concerns, phantasies and fears of our children.

"What is the evidence?"—this key question should be asked by anyone reading this. The evidence is partly internal, in that the implied philosophy of education of this thesis carries its own weight. It is also partly objective, in that such a procedure has been employed in some schools—with good success. There is room for much experimentation though. We need much educational research on the elementary level, to find out, whether or not our science teaching meets the needs of our society, and the ever-present needs and interests of our children.

REPORT OF THE NOVEMBER 27–29, 1952 CHICAGO CONVENTION

Appreciation: The Board of Directors formally recognized the excellent work of the team that designed and executed the plans for the 1952 Chicago Convention in a resolution accepting these plans with high commendation and gratitude from Mr. Edward Bos, General Coordinator.

The Association recognizes herewith its indebtedness to the following vice chairmen and through them to their committeemen: E. W. Hamilton, Charles W. Hill, L. T. Lucas, Joe Dickman, Joe McMenamin, James M. Sanders, Herbert Sauer, Virginia Terhune, and Frank H. Ulveling.

Official Association Meetings

I. The Board of Directors Meeting Thursday, November 27, 1952, 7:30 P.M., American Room, Edgewater Beach Hotel

1. Roll Call: Present: Officers: Peak, Leonhard, Edwards, Soliday; Past President: Lentz; Directors: Gibb, Habat, Haggard, Junge, Lauterbach, Lauby, Leach, Marth, Mayor, Pella, Price, Shepard; Journal Editor: Warner; Yearbook Editor: Shelter; Committee Chairmen: Bos, Gingery, Potzger, Teeters; Guest: Past President Meyer.

2. Disposition of the Minutes of Previous Official Meetings: It was moved (Soliday), seconded (Leach), and carried that the reading of any previous official Board or Association meetings be dispensed with since all previous minutes of said meetings had either been published in the Journal or individually supplied to those concerned.

3. Special Reports: (All reports were individually and formally received by vote of the Board of Directors):

3(a). State of the Union: President Peak: All convention plans and details thereof have been completed. Problems and/or issues confronting the Association will come to the attention of the directors through the reports of the several administrative committees.

3(b). Membership: Harold W. Haggard: Chairman Haggard filed a report in which he raised these questions, 1, What is the non-renewal date line that removes a "delinquents" name from the Association's membership roll, 2, Is it effective to charge sections chairmen with some new membership soliciting responsibility, and 3, What is the most effective date for the membership to receive their yearbooks?

Mr. Lentz inquired about the mechanics of non-renewals. Mr. Haggard replied that he contacted the membership committee representative in the area of the non-renewer upon notice of delinquency from Mr. Soliday. The latter then responded that he sends two notices of expiration of membership and follow-up letters and then removes the name from the roll.

Questions 2 and 3 in Mr. Haggard's report were discussed, he was asked to confer with the Journal Committee (he did so), and final disposition of these two questions will be found in Part III, Sections 2 (9) and 2 (4). of this Report.

3(c). Local Arrangements: Edward Bos: Refer to "Appreciation" preceding. Mr. Bos outlined the arrangements and stated that convention costs would approximate $220.

3(d). Student Exhibits: The chairman, Mr. McMenamin could not attend the convention due the death of an aunt. The Board directed the Secretary to send Mr. McMenamin an appropriate message of sympathy. (This has been done).

Mr. Habat presented for consideration the possibility of choosing and awarding honors among the student exhibitors and then sending on the winners to the several student science fairs featuring such contests and exhibits. His suggestion was referred by the Board to the Policy and Resolutions Committee for recommendation.

As had been made in previous meetings of this Board the suggestion was again made that current chairman of the Student Exhibits Committee be appointed to membership on this committee the following year.

3(e). The Detroit Drop-out Study: Fred D. Leonhard: Mr. Leonhard read this report in the absence of Chairman Robert Lankton. The questionnaire method was used in securing the material for this report and the respondents were from non-renewals in the Detroit area. Several significant reasons for non-renewal were brought out, the chiefest being the absence of personal contact when renewal time has arrived.

The directors were highly pleased with the careful and effective work of this committee and highly commended Chairman Lankton and his aides: Miss Geraldine Dolan, Mr. James Dilbeck, Mr. Fred Leonhard and Mr. Allen Meyer.

3(f). The Journal: Glen W. Warner: This report contained three points, 1, four of the departmental editors had responded to the Board's resolution of May 10, 1952, that each departmental editor contribute one "tricks of the trade" item per issue of the Journal, 2, new departmental editors are needed for general science and zoology and 3, help is needed in reviewing new text books.

Mr. Leonhard raised the question and Mr. Leach asked Mr. Warner to comment on the possibility of using one issue of the Journal as a yearbook issue.

Mr. Warner observed that if this were done then either the number of pages in the yearbook issue would have to be materially increased or the effectiveness of this issue for 75% of its readers significantly reduced.

3(g). Journal Committee: Walter G. Gingery: This gentleman said that his committee had not met formally during the year but there had been a deal of correspondence flowing to and fro among the members. Mr. Warner and Mr. Haggard both suggested that appointees to the Journal Committee in the future be selected within "meeting distance" of each other, but the idea was not seconded.

3(h). Yearbook: Luther Shetler: The fiscal transactions of the 1952 Yearbook had not been completed at this time but Mr. Shetler estimated that the publication would lose about $300 this year.

This loss was attributed to the new editor's having to learn the ropes, to increased printing costs, to fewer advertisers and to an exhibit space cost item of $400 that had not been anticipated in time to spread over the advertising rates.

The Board addressed itself to the problems of the future of the Yearbook. The factors examined and considered at length were reducing the number of copies printed, increasing the advertising rates, distributing the yearbooks (if, indeed, they are to be continued) on, or about, October 1st., replace the yearbook with mimeographed publicity material, reduce the number of pages by compressing committee listings and/or omitting the membership list, increasing the effective distribution, and incorporating the yearbook into the October issue of the Journal or making the October issue of the Journal a yearbook issue.

The Board action: 1, The 1952–1953 president of the Association shall appoint a temporary yearbook committee responsible for recommending to the Board yearbook economies. (Lauby, Mayor, C), 2, Later, the Board returned to the yearbook problem and voted to reconsider this preceding motion. (Mayor, Soliday, C), 3, The resolution was then revised to read, "The problem of economies in the publication of the Yearbook shall be referred to the Journal Committee for recommendation." (Mayor, Price, C), and 4 the preceding revision was referred to the committee mentioned. (Mayor, Price, C).

3(i). Policy and Resolutions and Policy Projects: H. Vernon Price: It was the recommendation of this committee that the following memorial be inscribed on the records of the Association by the Secretary on behalf of the officers, the directors, and the membership of the Central Association of Science and Mathematics Teachers recognizing the indebtedness to and honoring the name of Edwin W. Schreiber:

"With the passing of the late Edwin W. Schreiber the Central Association

and its constituent members have lost an esteemed colleague, a loyal friend, and a faithful servant. Although he concerned himself with many aspects of education, Mr. Schreiber seemed to be especially interested in people. This interest was reflected, to a marked degree, in the enthusiastic and conscientious manner in which he performed his duties as Association Historian, an office which he virtually created and which will long be associated with his name. He was a humble man, yet his influence and service were great. It is especially fitting that we affix to his record the simple benediction, WELL DONE."

The general opinion prevailed that no action for the moment need be taken on the committee's proposal that every third year there be a complete audit of the Association's fiscal records and that other years there be whatever minimum audit the laws may require.

The Policy Projects were to be reported on by Mr. Price and by Mr. Mallinson at the General Session on Friday morning and by Mr. Price in his committee report to the Board on Saturday afternoon, and President Peak referred the matter of the identity of the policy projects coordinator to Mr. Price's committee for recommendation later.

3(j). A.A.A.S. Cooperative Committee: Donald W. Lentz: The efforts and attention of this committee are directed toward the problems of the manpower shortage in the scientific and technical fields and the enrichment in the curriculum for the gifted student. Other phases of this committee's responsibilities are by no means being neglected however.

3(k). Historian Selection Committee: Cecelia J. Lauby: This committee attempted to get guiding opinions from responses to a questionaire posing three questions, 1, should the present office of Historian be retained, 2, would it be desirable to combine the office of Historian with a new post, public relations or publicity chief, etc. and 3, if the answer to questions 1 and/or 2 were yes, then suggest the name of some Association member qualified for the tasks.

There were no conclusive results, the whole area included in this report or implied to be included was thoroughly discussed and the issue was then referred to the Policy and Resolutions Committee for recommendation.

3(l). Anniversary Publication: John E. Potzger: This report was read by the chairman. It outlined in detail the energetic and resourceful efforts of this committee to dispose of the some 1200 unsold copies of the Anniversary book. Inspite of Herculean labors the sale of these copies remains pitifully low, but 42 having been sold the past six months, and the chairman requested and suggested that he and his committee be relieved by the incoming Association president.

The Board expressed its gratitude and sincere appreciation to the Anniversary Publication Promotion Committee for its unceasing concern, devotion to duty and time.

3(m). Supplementary Publications: No report was received.

3(n). Place of Meeting: W. R. Teeters: Inquiry was made of the Board and the Board confirmed the policy and the practice of meeting two consecutive years in Chicago and the third year outside of Chicago. Their second question concerned the effect the financial status of the Association might have on this policy this year. The Board assured Mr. Teeters that present finances indicated a continuence of the policy just stated.

3(o). Treasurer's Report: Ray C. Soliday: In the fiscal year ending June 30, 1952, there was an indicated net loss from operations of $114.76 due primarily to a decrease in advertising and to memberships being the lowest in the past five years. Hopes for a brighter future rests upon more advertising, a pickup in membership, moving the Anniversary books, and the fact of printing costs actually being under a year ago.

The auditor recommended not carrying on the balance sheet henceforth the two assets accounts, Advertising Accounts at $1000.00 and Subscription Lists at $3500.00 No action was taken although the suggestion was thoroughly considered.

Various items in the budget were discussed with most of the thought being directed to increasing revenues and to reducing the costs of conventions.

4. Communications: Dr. William David Reeve sent his greetings and best wishes to the officers, the Directors, and the members of the Association.

A telegram containing felicitations was received (but too late for presentation to this session of the Board) from Past President Paul L. Trump and this message from him reflected Paul's unfailing thoughtfulness, cordiality and sincerity.

Mr. S. W. Blum asked permission to attend the convention as a guest. President Peak wished to be responsible for Mr. Blum and the Board so concurred.

Mr. Leonard Olsen of Case Institute would appreciate the favor, could it be granted, to have an Interstate Physics Institute publicized. The Board thought that there would not be time or opportunity during the convention and referred Journal publicity to Mr. Warner for his decision.

5. Old Business:

5(a). Policy Projects Coordinator: Refer to Part III, Section 2 (6) following in this Report.

5(b). Saturday Morning Sessions. No action was taken.

6. New Business:

6(a). Emeritus Members: Mr. S. R. Powers and Mr. Theodore Kelsey, upon whom Emeritus memberships were to have been conferred, could not attend the ceremonies in their honor. These honors are to be presented "in absentia" at the Banquet by Charlotte Grant at the time originally anticipated.

6(b). Membership Termination Dates: Refer to Part I, Section 3 (b), paragraph 2, preceding in this Report.

6(c). Dissemination of Projects Information: Refer to Part III, Section 2 (11), following in this Report.

6(d). Announcements of Outside Organizations: Refer to Part I, Section 4, paragraph 4, preceding in this Report.

Adjournment.

II. The Annual Business Meeting

Saturday Morning, November 29, 1952, at 9:00 A.M., Ballroom

1. Disposition of Minutes of Preceding Official Meetings: The reading of any and all preceding minutes of the official meetings was ordered omitted. (Warner, Haggard, C).

2. Necrology Report: Glen W. Warner: The assembly stood, and with bowed heads observed a moment of silence in reverance for and in tribute to the memory of Dugald C. Jackson, B. S. Hopkins, Edwin W. Schreiber and A. M. Welchons.

3. Committee Reports:

3(a). Membership: Harold W. Haggard: Registration at the convention was distributed: 313 members, 105 guests, total 418.

3(b). Place of Meeting: W. R. Teeters: This committee's recommendation that the 1953 and 1954 conventions be held in Chicago was approved.

In answer to Mr. Lowry's question, Mr. Teeters explained that the Board had in May, 1952, set up the policy of reporting the convention sites two years in advance, and, further, that no one outside of Chicago had invited the convention elsewhere.

3(c). Anniversary Publication: John E. Potzger: The chairman reviewed briefly the report he had made to the Board the preceding evening (See Part I, Section 3 (1), preceding).

3(d). Local Arrangements: Edward Bos: Mr. Bos had previously reported to the directors, so he confined his remarks to a request for comments and criticisms for his use in compiling his final report for the guidance and convenience of future coordinators. Mr. Bos and his staff were accorded a round of well deserved applause.

3(e). Nominating Committee: John E. Potzger: The entire slate proposed by the Nominating Committee was endorsed by the Convention: Cecelia J. Lauby

for President, Edgar S. Leach for Vice President, Milton O. Pella for Director, term expiring in 1953 and replacing Cecelia Lauby, John E. Habat, Ella Nichols, J. S. Richardson and Iva Spangler for Directors for terms expiring in 1955.

These nominees were introduced and Dr. Lauby responded on behalf of her team and on her own behalf pledging unceasing best and pleading for everyone to get under the load and help mightily to lift.

President Peak thanked one and all for their help, cooperation and encouragement during his regime.

Adjournment.

III. The Board of Directors Meeting Saturday, November 29, 1952
1:00 P.M., in the Illinois Room

1. Roll Call: Present: Officers Peak, Leonhard, Edwards, Soliday; Electees: Lauby, Leach, Habat, Pella, Nichols, Spangler, Richardson; Directors: Gibb, Junge, Marth, Mayor, Price, Shepard, Haggard; Editor: Warner.

2. Policy and Resolutions Committee: H. Vernon Price: This report of eleven points was received by the Board in its entirety (Leach, Marth, C). Resolutions establishing policy or procedure are indicated following the sections so recognized by the Board. The report:

(1). The Business Manager is to secure and supply to the Policy and Resolutions Committee prior to and in time for this committee to base a recommendation to the May, 1953, meeting of the Board of Directors a report on cost data on spot-check yearly audits and/or complete audits every three years. Resolution: The Business Manager is to be so directed. (Mayor, Pella, C).

(2). The local committee on student exhibits is to be appointed at an early enough date to allow ample time to plan, assemble and set up their exhibits.

There shall be no distinction among student exhibitors, but all shall be equally honored and recognized by an appropriate certificate and recognition on the platform at the first general session.

The first general session shall have but one speaker in order that there be ample time to recognize the student exhibitors.

(3). The Journal Committee is to be given the responsibility for all publications of the Association and is to be considered a publications committee. Resolution: So approved. (Mayor, Leonhard, C).

(4). The October issue of the Journal shall absorb the Yearbook. This precipitated another vigorous discussion of what to do about the Yearbook. President Peak asked Mr. Warner to read Mr. Gingery's Journal Committee report at this time since Mr. Warner had indicated that the Yearbook problem was addressed in this latter report. The Journal Committee was flatly opposed to incorporating the Yearbook into the October issue of the Journal or of making this issue a Yearbook issue, to dispensing with the membership list or to mimeographing any part of the Yearbook material. Finally the Board resolved: "The Yearbook in its present form is to be continued on a trial basis for one more year, is to pay for itself, and is to be issued on or about October first, 1953." (Mayor, Pella, C).

(5). The Detroit Committee on Non-renewals Study is to be thanked for its work, highly commended for its fine service and released from further duty on this assignment. Resolved: This committee is to be so directed. (Haggard, Leach, C).

(6). The Coordinator of Policy Projects Committees shall be appointed for a three year term and shall be an ex-officio member of both the Policy and Resolutions Committee and of the Board of Directors. Resolution: So ordered. (Lauby, Leonhard, C).

(7). It is recommended that the Teacher Training Policy Projects Committee be reconstituted.

(8). It is recommended that consideration of sustaining memberships be postponed.

(9). It is recommended that publicity be handled by local arrangements and membership committees.

(10). An Historian is to be appointed to serve for a three year term. Resolution: So ordered. (Leach, Haggard, C).

(11). It is strongly recommended that all final reports on Policy Projects be presented through the Coordinator to the Policy and Resolutions Committee for final editing and then shall be published in the Journal.

3. Journal Committee: George W. Gingery: (Report read by Mr. Warner). The report was formally received by the Board. The report may be summarized:

(1). The Yearbook in its present form should not be abandoned or any of it mimeographed.

(2). Economies in the Yearbook might be effected by (a), buying the type used for the membership and the past presidents lists and adjusting this yearly, (b), considering using offset printing, (c), condensing the committees listings material and selling this released space to more general advertising. (d), obtaining competitive bids from printers, (e), starting earlier on the job by the editor, (f), continuing the policy of retaining the editor over a period of several years, (g), increasing the number of advertisers.

(3). Journal publication problems considered were (a), continue the present price, number of issues and Journal content structure, (b), secure more advertising, (c), departmental editors should be selected and secured by the editor, (d), perhaps assistant editors and business managers should be employed, (e), no issues of the Journal should be made Yearbook issues until no other solution to the Yearbook's fate has been forthcoming, (f), the editorial policy of the Journal should be that the articles selected for publication be of primary interest to all members rather than segregating in one issue articles addressed to a particular segment of the membership.

4. Administrative Change: President Peak introduced Dr. Cecelia Lauby and turned over to her the honor and the responsibility of the office of President of the Central Association of Science and Mathematics Teachers. Madame President introduced the new Vice President, Mr. Edgar S. Leach. And, characteristic of both Cecelia and Edgar, when a job is theirs, their sleeves were already rolled up—in fact they had already gone to work on plans for 1953 with Vice President Leach to head up local arrangements.

5. New Business:

5(a). Expediting Association Business in Board Meetings: President Lauby commented upon the mass of items that come before the Board for disposition and upon the increasing amounts of such items. Agreement was complete and vigorous that something had to be done to expedite the disposition of business coming before the Board. One suggestion was that rather than require the presence of so many reportees their material be submitted in writing. Another thought was that these written reports be available well before Board meetings so that the directors and officers would have had time to think through the problems involved or implied in the reports. Why not have this material screened by the Executive Committee prior to consideration in Board meetings, was asked. Dr. Junge pleaded for more time in which to really solve some of the urgent problems and there-upon it was moved (Pella), seconded (Price) and carried that President Lauby arrange such meetings of the Board of Directors during the convention days in 1953 of Thursday, Friday and Saturday as she deemed necessary to complete the Association's business.

5(b). Directors and Officers Association Expenses: The consensus of opinion was that the resolutions of previous Boards of Directors in the matter of reimbursing directors and/or officers of the Association for expenses incurrred on Association business were not binding upon the present or future boards.

5(c). Authorizing the Business Manager to Pay Association Due Bills: The consensus of opinion was that the Business Manager was to continue to meet due bills contingent upon the Association's ability to pay.

6(d). Fiscal Agents: The River Forest State Bank was again designated as the Association's fiscal agent and the depository of its funds, and Ray C. Soliday was designated to draw checks upon these funds in payment of the Association's financial obligations. (Junge, Gibb, C).

6(e). Requests: Requests that the Association actively cooperate were received from the Chicago Commission on Science Careers and from the Federation of Paint and Varnish Clubs. These inquiries were turned over to the Executive Committee for investigation and recommendation for action. (Price, Junge, C).

6(f). Place of Meeting in 1953. Details: There was some discussion as to possibilities other than the hotel housing the current convention. The general opinion was that these details could be left to the decision of the Executive Committee upon recommendation of Vice President Leach who will be in charge of local arrangements.

Adjournment.

Programs

Programs details may be found in the 1952 Yearbook, copies of which were sent to all members and given to all new members. All papers read in the general sessions, in the sections meetings and in the groups will be printed in the Journal and hence are not reported here.

Sections Officers Elected for 1953

Biology: Chairman, Nelson L. Lowry; Vice Chairman, James H. Otto; Secretary, Robert Smith.

Chemistry: Chariman, T. A. Nelson; Vice Chairman, Robert C. Grubbs; Secretary, Louis Panush.

Elementary Mathematics: Chairman, Glenadine Gibb; Vice Chairman, Herschell Grime; Secretary, F. Lynwood Wren.

Elementary Science: Chairman, Muriel Bueschlein; Vice Chairman, Louis Rzepka; Secretary, Sister Mary Evarista.

General Science: Chairman, Sister Mary Ellen O'Hanlon; Vice Chairman, Marjorie Barnes; Secretary, John D. Woolever.

Geography: Chairman, Alice Wetterlund; Vice Chairman, Anna Alexa; Secretary, Elizabeth Fristoe.

Mathematics: Chairman, Geraldine Dolan; Vice Chairman, Reino Takala; Secretary, Dwain E. Small.

Physics: Chairman, Kenneth E. Vordenberg; Vice Chairman, G. A. Waldorf; Secretary, Bastian Fagginger-Auer.

Respectfully submitted,
W. H. Edwards, *Secretary*

REPORT ON THE JOINT MEETING OF THE BIOLOGY SECTION AND THE CONSERVATION GROUP

James H. Otto
Secretary, Biology Section

I. Address: "The Ecology in Conservation," Howard H. Michaud, Associate Professor of Conservation, Purdue University, Lafayette, Indiana.

Knowledge of ecology—the relations of plants and animals to their surroundings—is fundamental to the understanding of problems in conservation. For this reason ecology deserves a major emphasis in high school courses in Biology. Ecology as a science lies within the scope both of interest and comprehension of the high school pupil and represents a fusion point for all natural sciences.

Man's natural heritage is a product of many ages past, operating in an ever changing present world. Our present biotic communities relate to climate, soil,

topography and other physical factors as well as to the dynamic influence of living things on each other.

The living world exists as a biotic pyramid. Soil forms its base. Plants, insects and other forms of animal life exist in layers, one depending on another. Carnivorous animals form the top layer. In all cases, the organisms consumed must be more numerous than the animals feeding.

Succsession is a movement of plants and animals toward a biological balance. Man has greatly disturbed this balance by destroying parts of it for his own personal exploitation and through a rapidly expanding agriculture and industry. The balance has been further upset by the accidental or deliberate importation of exotic organisms. As the balance is upset some organisms prosper while others suffer or perish. This problem requires conservation management. The greater becomes man's influence on his environment, the greater the conservation management problem he creates.

For example, the widespread and heavy use of DDT for mosquito control in Florida took a toll of myriads of fish, frogs, toads and other organisms. These losses created a critical disturbance of the biological balance.

A conservation program requires, at its outset, a program in human conservation. Management of Man is vital from the standpoint of his attitude toward his influence on environment and the manner in which environment affects him.

II. Panel: "Resourceful Techniques in the Teaching of Conservation," Leader: Dr. Richard L. Weaver, Conservation Project Leader, National Association of Biology Teachers, Raleigh, North Carolina.

Resource Persons: Robert Smith, DeKalb, Illinois, High School; Jack Hood, Michigan Department of Conservation; Robert Finlay, Ohio Department of conservation, Prevo L. Whitaker, Indiana University; Bernard Wievel, Wisconsin State Teachers College.

The Panel discussed the following points: 1. The place of conservation in the curriculum. 2. Resource problems as teaching devices. 3. Schools grounds development as an example of a conservation project and a means of building an outdoor laboratory. 4. Conservation activity in cooperation with parks departments, civic groups, sportsmen's clubs and allied groups. 5. Effective use of resource people in conservation education. 6. Exhibits of conservation projects. 7. Field trips in the teaching of conservation.

III. Conservation Work Conference. Leaders: Dr. Michaud and Dr. Weaver.

Dr. Weaver discussed the Conservation Project of the National Association of Biology Teachers. He introduced the states chairmen (Refers to "Resource Persons" in Section II preceding) who, in turn, reported on conservation plans progress in his state. In each instance the reports were most encouraging and gratifying.

Mr. Arthur J. Baker, Crystal Lake (Illinois) High School, conducted a work period in which all members were divided into groups by states. Specific plans, problems and teaching devices in conservation were discussed in these work groups.

The afternoon program was concluded with a summary of the suggestions of each group by the groups chairmen and an evaluation of the work shop proceured by Dr. Michaud.

REPORT ON THE SENIOR HIGH SCHOOL GROUP MEETING

Reino M. Takala, *Chairman*

Panel: "What Can Science and Mathematics Teachers Do to Bring Their Students an Understanding of Significant Figures in Measurement?"

Resource Persons: Norvil Beeman, Chemistry, R. W. Woline, Physics, and Reino M. Takala, Mathematics, all from Oak Park and River Forest High School.

The panel developed the principle that results obtained in computations involving measurements are accurate only to the least number of significant figures in the data used. Illustrations were cited in problems relating to area, volume, laws of gases and computing the volume of water in a test tube.

Problems of presenting the principle of significant figures to students were discussed, and sources of materials on the topic were presented.

Emphasis was put upon the fact that we are not so primarily concerned with great precision of measurement in the work of beginning students as with an understanding of two other factors, 1, the degree of precision consistent with the measuring instruments and 2, the accuracy of the data obtained in measurement.

If we give this understanding to students, they will learn to use measuring instruments intelligently and gain for themselves a confidence in the results of their quantitive work.

PROBLEM DEPARTMENT

CONDUCTED BY G. H. JAMISON

State Teachers College, Kirksville, Mo.

This department aims to provide problems of varying degrees of difficulty which will interest anyone engaged in the study of mathematics.

All readers are invited to propose problems and to solve problems here proposed. Drawings to illustrate the problems should be well done in India ink. Problems and solutions will be credited to their authors. Each solution, or proposed problem, sent to the Editor should have the author's name introducing the problem or solution *as on the following pages.*

The editor of the department desires to serve its readers by making it interesting and helpful to them. Address suggestions and problems to G. H. Jamison, State Teachers College, Kirksville, Missouri.

SOLUTIONS AND PROBLEMS

Note. Persons sending in solutions and submitting problems for solutions should observe the following instructions.

2. Give the solution to the problem which you propose if you have one and also the source and any known references to it.

3. In general when several solutions are correct, the ones submitted in the best form will be used.

Late Solutions

2327. *Sadie Pack, Dundee, Mich.; A. R. Haynes, Tacoma, Wash.; Irene Williams, Linden, Mich.*

2326, 7, 9. *Julian H. Braun, Washington, D. C.*

2328. *Grace La Boyteaus, Linden, Mich.*

2322. *Arthur S. Schwartz, Dorothy A. Stark, Norman B. Stough, all of Los Angeles City College.*

Error

In problem **2325**, November 1952 issue, the "7" of the first equation should be replaced by 17.

2329. *Proposed by V. C. Bailey, Evansville, Indiana.*

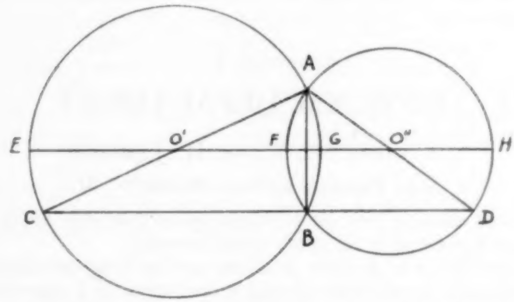
Show that the inradius of the triangle EFG, where E, F, G are feet of the altitudes of triangle ABC, is given by formula: $r=2R \cos A \cos B \cos C$, with R the radius of the circumcircle.

This problem appeared in the May, 1952 issue of SCHOOL SCIENCE AND MATHEMATICS as **2305,** with solution and correction published November, 1952.

2330. *Proposed by C. W. Trigg, Los Angeles City College*

If the centers of two intersecting circles with radii R and r are at a distance d apart, then show that the length of the common chord is

$$\sqrt{(R+r+d)(R-r+d)(R+r-d)(r-R+d)/d}$$



Solution by Aaron Buchman, Buffalo, New York

The proposed problem had a misprint in that the radical sign should not extend over the denominator. Let $2h$ be the common chord. Then it is at once evident that h is the altitude to side d of a triangle with sides R, r, d. Let K be the area of this triangle, and express K in terms of the base and altitude, and in terms of the three sides.

Then

$$K=\tfrac{1}{2}hd=\tfrac{1}{4}\sqrt{(R+r+d)(R-r+d)(R+r-d)(r-R+d)}$$

From this relation it follows at once that

$$2h=\sqrt{(R+r+d)(R-r+d)(R+r-d)(r-R+d)}/d$$

Editors note: Leon Bankhead in his solution offers a very interesting comment. By referring to the diagram the four factors of the radicand are line segments on the line of centers. Thus;

$$R+r+d=EH$$
$$R+r-d=FG$$
$$R-r+d=EF$$
$$r-R+d=GH$$
$$d=o'o''$$

We then have

$$(AB\cdot o'o'')^2=EF\cdot FG\cdot GH\cdot HE.$$

Solutions were also offered by: Davis Allen, Hammond, Ind.; Warren Rufus Smith, Sutton's Bay, Wis.; Robert Glahn, Kirksville, Mo.; Richard R. Williams, Jr. Marshall, Texas; Wm. F. Wilcox, Jr. Ypsilanti, Mich.; Nathaniel Grossman, Aurora, Ill.; R. L. Moenter, Fremont, Neb.; Julian Braun, Washington, D. C. and the proposer.

2331. *Proposed by Zora Bailey, Sayres, Pa.*

Solve

$$x^4y^2+2x^3y+x^2+2xy^3=x^2y^4+y^2+x^2y^2$$
$$x^2y+xy^2+x=2xy+y$$

Solution by Richard R. Williams, Jr. Wiley College, Marshall, Tex.

Set $X=x^2y+x$, $Y=xy^2-y$ and rewrite the given system of equations as

(1) $$X^2-Y^2=x^2y^2, \qquad X+Y=2xy$$

Solving (1) for X, Y and replacing X by x^2y+x and Y by xy^2-y we get

(2) $$x^2y+x=5xy/4, \qquad xy^2-y=3xy/4$$

The equations (2) yield the two solutions

$$x=(-17+\sqrt{1249})/24, \qquad (-17-\sqrt{1249})/24$$

$$y=(47+\sqrt{1249})/40, \qquad (47-\sqrt{1249})/40$$

Solutions were also offered by R. L. Moenter, Freemont, Neb.; and the proposer; also Julian Braun, Washington, D. C.

2332. *Proposed by Richard H. Bates, Milford, N. Y.*

A group of 7 boys had some marbles. In an attempt to divide them equally there were 2 left over. Three more boys joined the group and when the division was again made, a remainder of 9 was discovered. Now another boy joined the group and this time 3 remained after an equal distribution was made. How many marbles did the boys have?

Solution by Gerald E. Doeden, Valparaiso, Ind.

If we let $x=$ the total number of marbles, $a=$ the number of marbles for each person in the first group, $b=$ the number for second group and c the number for third group, then we have the following equations:

(1) $$7a+2=x$$

(2) $$10b+9=x$$

(3) $$11c+3=x$$

Solving the first two for a and the last two for b we get

(4) $$a=\frac{10b+7}{7}$$

(5) $$b=\frac{11c-6}{10}$$

It is obvious that if a, b, and c are integers, the values of c from the last equation have to be 6, 16, 26, 36 etc. Using these and solving for a value of b that would make a an integer in equation (4) we find that 26 satisfies the conditions. Substituting we find that the total numbers of marbles is 289. The first portion is 41, the second, 28, and the third is 26.

Other values for c would be 96, 166, 236, 306, etc. Other values for the number of marbles would be 1059, 1829, 2599 or $289+770n$.

Solutions were also offered by: Aaron Buchman, Buffalo, N. Y., R. L. Moenter, Fremont, Neb., James Means, Houston, Texas, Ernest H. Kanning III, Valparaiso, Ind., Leon Bankoff, Los Angeles, Richard H. Bates, Milford, N. Y., Nathaniel Grossman, Aurora, Ill. George Grossman, New York City, Warren Rufus Smith, Sutton's Bay, Mich., Richard R. Williams, Jr. Marshall, Texas, Kenneth P. Kidd, Gainesville, Fla., George Janicki, Chicago, Julian H. Braun, Washington, D. C.

2333. *Proposed by John Satterly, University of Toronto.*

In a triangle ABC, if a point B_1 is selected on side a, such that $BB_1=a/n$, then AB_1 is called a nedian of the triangle. From each vertex there are three such points extending in same directions around the triangle, and also three points extending in the opposite direction. Hence there are two sets of three nedians each. The medians of each set form a triangle called a nedian triangle.

One triangle may be called the forward triangle, and the other the backward triangle.

Problem—The sum of the squares of the nedians of a set in triangle ABC equals $(a^2+b^2+c^2)(n^2-n+1)/n^2$.

Solution by Richard H. Bates, Milford, N. Y.

Let x_1, x_2, and x_3 be the 3 nedians of a set.

By Stewart's Theorem:

$$x_1^2a=c^2\cdot B_1C+b^2\cdot BB_1-a\cdot BB_1\cdot B_1C$$

$$x_1^2a=c^2\cdot\frac{a(n-1)}{n}+b^2\left(\frac{a}{n}\right)-\frac{a^3(n-1)}{n^2}$$

$$x_1^2=\frac{c^2(n-1)}{n}+\frac{b^2}{n}-\frac{a^2(n-1)}{n^2}$$

Similarly:

$$x_2^2=\frac{c^2}{n}+\frac{a^2(n-1)}{n}-\frac{b^2(n-1)}{n^2}$$

$$x_3^2=\cdot\frac{b^2(n-1)}{n}+\frac{a^2}{n}-\frac{c^2(n-1)}{n^2}$$

Adding:

$$x_1^2+x_2^2+x_3^2=\left(\frac{n-1}{n}\right)(a^2+b^2+c^2)+\frac{1}{n}(a^2+b^2+c^2)-\left(\frac{n-1}{n^2}\right)(a^2+b^2+c^2)$$

$$=\left(\frac{n-1}{n}+\frac{1}{n}-\frac{n-1}{n^2}\right)(a^2+b^2+c^2)$$

$$=\left(\frac{n^2-n+1}{n^2}\right)\cdot(a^2+b^2+c^2)$$

Solutions were also offered by Leon Bankoff, Los Angeles and Robert Glahn, Kirksville, Mo.

2334. *Proposed by John Satterby, University of Toronto.*

The area of a nedian triangle is $(n-2)^2/(n^2-n+1)$ times the area of the triangle.

Solution by Richard H. Bates, Milford, N. Y.

Let E be the intersection of Nedians CB_1 and AC_1, F the intersection of AC_1, and BA_1, and G the intersection of CB_1 and BA_1. Let H be the foot of BE meeting AC.

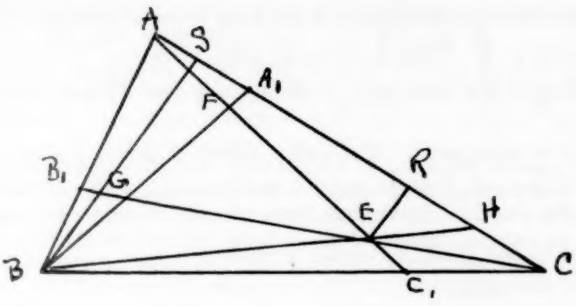
Then B_1HC_1 is the pedal triangle of ABC and by theorem p. 131 section 245—Court's College Geometry

$$BB_1/AB_1+BC_1/CC_1=BE/EH$$

From the definition of a nedian; it follows that

$$BE/EH=(n^2-2n+2)/(n-1). \qquad (1)$$

Draw perpendiculars ER and BS to AC making triangles BSH and ERH similar.



Now

$$BH/EH = BS/ER = ABC/AEC$$

From (1)

$$BE/EH = (n^2-2n+2)/(n-1).$$

It follows that

$$BH/EH = (n^2-n+1)/(n-1) = ABC/AEC$$

or

$$AEC = (n-1)/(n^2-n+1)\cdot ABC$$

Similarly:

$$BGC = (n-1)/(n^2-n+1)\cdot ABC$$

and

$$BFA = (n-1)/(n^2-n+1)\cdot ABC.$$

The nedian triangle

$$EFG = ABC-(AEC+BGC+BFA) = ABC\cdot\left[1-3(n-1/n^2-n+1)\right]$$
$$EFG = ABC\cdot\left[(n-2)^2/(n^2-n+1)\right]$$

Dr. Leon Bankoff offers a proof based upon a proof given in Educational Times, V. 7, July 1867. He also mentions that the proof that all nedian triangles have the same centroid may be found in Mathematical Snack Bar, W. Heffer and Sons, Cambridge 1936 pp. 12–13. Also see #2273, Feb. 1952 of this magazine for a general solution of this problem.

HIGH SCHOOL HONOR ROLL

The Editor will be very happy to make special mention of high school classes, clubs, or individual students who offer solutions to problems submitted in this department. Teachers are urged to report to the Editor such solutions.

Editor's Note: For a time each high school contributor will receive a copy of the magazine in which the student's name appears.

For this the Honor Roll appears below.

PROBLEMS FOR SOLUTION

2347. *Proposed by C. W. Trigg, Los Angeles City College*

P is any point on the incircle of a regular n-gon. Show that the sum of the squares of the distances from the vertices of the n-gon is $n(r^2+R^2)$, where r, R are the radii of the inscribed and circumscribed circles respectively.

2348. *Proposed by Leon Bankoff, Los Angeles*

Show that $\cos 10\theta - \cos 11\theta$ is divisible by $2\cos 7\theta + 1$ and find the other factor.

2349. *Proposed by C. W. Trigg, Los Angeles City College.*

Find five different fractions, each of the form $m/(m+1)$ such that their sum is an integer.

2350. *Proposed by Margaret F. Willerding, Harris Teachers College, St. Louis.*

Use (a) the half-angle formula and (b) the formula for the difference of two angles to find the sine 15°. Prove that these two radical forms are equivalent.

2351. *Proposed by Roy Wild, University of Idaho.*

If $f[f(x)] = x^2$, find $f(x)$.

2352. *Proposed by A. R. Haynes, Tacoma, Wash.*

Show by elementary geometry that the sides of any triangle ABC bisect the exterior angles of its pedal triangle.

BOOK REVIEWS

INTRODUCTORY GENERAL PHYSICS, by John Gibson Winans, *Associate Professor of Physics, University of Wisconsin.* Cloth. Pages x+765. 15.5×23 cm. 1952. Ginn and Company, Statler Building, Boston 17, Mass. Price $5.75.

This text is for use in a beginning course in college physics. The reviewer is not familiar with all the books published for such a course. But of those seen, this text is outstanding for the way it is presented for such a class.

The author states that the book "is designed for students who approach the course with little previous background in high school mathematics or science, yet whose college or professional interests require a simple but thorough and workable grounding in the principles of physics."

The author is consistent with this premise throughout the text. The first chapter "Words and Measurements," defines the fundamental quantities of physics and how they are measured. The second chapter "The Algebra and Geometry of Physics," gives a brief but very important review of the mathematics used in the book.

The book is profusely illustrated with pictures and diagrams. These are well chosen and appropriately placed. New ideas or thoughts in each chapter are introduced with capital letter sideheads. This arrangement is very useful to students in skimming and reviewing a chapter. The formulas are developed step by step so that the student will understand their derivation. Then a problem is worked out for an example of the use of that formula. In addition, there is a brief, but well written, summary at the end of each chapter. Each chapter has ten or more appropriate problems at the end.

The appendix of 16 pages contains the usual tables plus an explanation on use of the slide rule and a summary of the quantities used in physics and how they are measured in different systems.

Since the book is so thorough in its explanation, the more brilliant student can soon learn how to skim the material he knows and select the parts for further study. This book would have great value to secondary school physics teachers. It would make a good reference text for use by the better high school students.

E. WAYNE GROSS
University School
Bloomington, Indiana

MATHEMATICS FOR ENGINEERS, by Raymond W. Dull, *Late Consulting Engineer,* and Revised and Edited by Richard Dull, *Engineer, Webster-Chicago Corpora-*

tion. Third Edition. Cloth. Pages xix+822. 14.5×21 cm. 1951. McGraw-Hill Book Co., Inc. New York City, New York. Price $7.50.

This book is the third edition of an original treatise written by the late Raymond W. Dull in 1926. The first edition, as is this, was written primarily for engineers. It was not the original intention of Mr. Dull to publish certain mathematical reference notes he had prepared; but rather, they were published after engineering friends suggested that they should be available in book form. Mr. Dull had felt engineer handbooks were too concise and incomplete and that mathematics textbooks' purpose was to give mental training as well as mathematical knowledge and hence were too detailed. In his notes he hoped to circumvent the deficiencies of each for his work. This book is for "(1) engineers who want a quick and convenient reference, (2) engineers who have grown somewhat rusty in their mathematics, and (3) engineers who feel the need of a text for the study of mathematics."

The third edition, revised and edited by Richard Dull, son of Raymond Dull, seeks to include new ideas and treatments to bring the text up-to-date. Additions have been made in the units on infinite series, trigonometry, complex vectors, and hyperbolic functions. A chapter on differential equations and a chapter on dimensional analysis are also included in this new edition.

The fifty-four chapters include mathematical subject matter starting with elementary algebra and covering topics to include hyperbolic functions, integration, differentiation, differential equations, and dimensional and similarity analysis. The book presupposes previous mathematics training and no attempt is made for a thoroughly logical development of mathematics. It is written in a language that is concise and simple.

This book should make a very worthwhile reference for every engineer. It might well be used by the mathematics teacher, or other individuals with interest in the area of mathematics, as a reference book.

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BUILDING MATHEMATICAL CONCEPTS IN THE ELEMENTARY SCHOOL, by Peter Lincoln Spencer, *Clarement Graduate School,* and Marguerite Brydegaard, *San Diego State College.* Pages ix+368. 1952. Henry Holt and Company, New York.

This book is of genuine interest to teachers of the first six grades, to their supervisors, and to elementary teachers-in-training in our teachers colleges. Emphasis is placed on an experimental approach to the discovery of facts and relationships in our mathematical system; this approach is presented in an effort to have mathematical learnings be ***understood*** rather than accepted as magic; for example, the chapter on ***Concepts Underlying Number Systems*** stresses the importance of place value, and another chapter stresses the importance of counting as *the one* fundamental process.

Through numerous pictures of children at work on experiments, and also through numerous illustrative lessons which are included in each chapter, the book gives an extremly wide variety of applications of quantitative thinking and doing. The illustrations include counting, determining a standard of measure, measuring with weights and lengths of various kinds, fraction applications to notes in music, the idea of balance in art, and many others. Throughout the book attention is given to comparisons and ratios; for example, if 8×1 equals 8, then $8\times\frac{1}{2}$ equals half as much, and 8×2 equals twice as much, as the first product.

At the end of each chapter a list of up-to-date "suggested readings" is included for anyone who desires to pursue further the topic of the chapter.

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THE ARITHMETIC OF BETTER BUSINESS, By Frank J. McMackin, John A. Marsh, and Charles E. Baten. Published by Ginn and Co., Chicago. 1951. Price $2.48 389 pages.

This book could be used in a one-year course in Business Arithmetic on the secondary level although it is not made clear just when it should be offered. As to types of instruction, it attempts first a purely remedial emphasis to further develop skill; it involves also a simple type of problem solving arithmetic; and third, it contains some aspects of arithmetic that involve business situations and which may also relate closely to the learnings presented in the bookkeeping classroom.

No plan, however, is introduced to do diagnostic testing until a chapter is finished. Then the diagnostic test serves as a basis for remedial instruction and is followed by an achievement test. Apparently the teacher must set up different learning standards for different individuals.

The objectives of this course seem to include the development of further speed and higher accuracy in the fundamental processes, facility in the use of short-cuts, although these must be examined from the standpoint of usability; the achievement of ability to estimate the common sense of an answer; the achievement of facility in problem reading and in the interpretation and solution of problems related to the principles of business and of life situations.

In carrying out these aims and in examining the textbook in some details it is obvious that a student must read carefully if he is to follow the detailed explanations often given of mathematical procedure. For instance, on page 6, in discussing rounding off numbers the student is told: 1. "Drop all figures beyond the desired unit of accuracy if they are at the right of the decimal point; change them to zero if they are at the left of the decimal point." However, the attempt to summarize procedures for all types of problems is an excellent device to help students follow through explanations of steps in solutions.

Also, on pp. 46–47, in regard to presenting "Helps for Faster and More Accurate Multiplication" the actual use that students will make of these is questionable. For instance, a short-cut such as the one on squaring any number ending in a 5 is illustrative.

In regard to assignments the teacher must rate the difficulty of the problems and decide what assignments should be given although each section contains "Practice Work" involving no story problem type of set-ups but rather just computational skill, whereas the Exercises which follow are in a problem set-up.

The section on graphs, Chapter 6, is an excellent presentation of how graphs are made and constructed.

In regard to Part II on the "Arithmetic in Business," no attempt is made to distinguish consumer business problems from trading and business organization problems except by chapter divisions. Many of the presentations in this section are done in a traditional manner and include the usual terminology and forms of the trade.

The use of many real-life illustrations gives the book a real atmosphere of business. The information on taxation and social security is up-to-date and is explained in a clear and understandable fashion. The explanations on postal savings and the operation of a Building and Loan Association are more exact than those of most authors. Also, the sections on stocks and bonds are very well done.

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SUN, MOON AND PLANETS, by Roy K. Marshall. Cloth. Pages x+129. 41 figures. 12.7×18.8 cm. Henry Holt & Co. New York. 1952. Price $2.50.

The author, while director and lecturer at the Fels Planitarium in Philadelphia, was flooded by many repetitious questions from his auditors. As a venture, for relief he prepared a series of leaflets which became the basis for this book.

Its sixteen chapter headings indicate the spread of the inquiries he had to

answer. Starting with "The universe we live in", there follows: Paths of planets; Exploring planets; Earth's atmosphere; Moon's motion; Eclipses; Trip to the moon; Satellites; Measuring the universe; The sun; Sun-spots; Little planets; Meteors; Comets and ending with Law of gravitation.

Dr. Marshall does not "talk down" or used forced analogies, yet he succeeds in an admirable manner in placing before his reader a clear, understandable account of the structure and motions of the bodies of the solar system. Both his ample training and skill in exposition make this small volume appealing to non-technical readers. This reviewer found it most helpful in bringing his knowledge of astronomy, learned two decades ago, somewhat up-to-date.

B. CLIFFORD HENDRICKS
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YOUR TELEPHONE AND HOW IT WORKS, by Herman and Nina Schneider. Cloth. Pages 96. Illustrations 108 by Jeanne Bendick. 14.0×20.3 cm. McGraw-Hill Book Co. Inc. 330 42nd Street, New York 36, N. Y. 1952 Price $2.00.

This small book, designed for fifth or sixth grade boys and girls, answers the question implied in its sub-title. By simple language, frequent use of analogy and the help of numerous cartoon-like line-drawings, it comes to grips with: Communication; Sound and sound-makers; Telephone accessories and how they work; Making a call (switch board); Calling by coin; Dial calls (Mechanical switch boards) and Traveling phones (Walkies, air, auto, ship, train etc.).

A two-page double column fine-type index helps to locate answers for those questions that did not occur at the time it was first read. The interested boy or girl will most likely read it to the end.

B. CLIFFORD HENDIRCKS

MATHEMATICS: A SECOND COURSE, by Myron F. Rosskopf, *Associate Professor of Mathematics and Education, Syracuse University;* Harold D. Aten, *supervising teacher and counselor in public schools, Oakland, California;* and William D. Reeve, *Professor Emeritus of Mathematics, Teachers College, Columbia University.* Cloth. Pages xviii+365. 15 by 22 cm. 1952. McGraw-Hill Book Company, New York, N. Y. Price $2.80.

This second course of secondary school mathematics takes up the logical presentation of geometry as the central theme. A basic assumption of this textbook is that the high school students can both master and enjoy demonstrative geometry. The manner of presentation of new material is one that helps the student to discover for himself the propositions of demonstrative geometry. The organization of material is such that emphasis is placed on the development of critical thinking both in mathematical and non-mathematical situations. Many exercises, experiences, and illustrations are provided to help the student to transfer to life situations the method of thinking that he acquires from the study of geometry. In each chapter the student is shown how to apply the type of reasoning studied in that chapter to non-geometric situations. Individual differences are provided for by means of graded exercises. At the end of each chapter there are two mastery tests. The first of these is geometric; it is designed to test the varying degrees of ability to recall and to apply the principles learned in the chapter. The second mastery test is non-geometric; its aim is to test the degree of carry-over to ordinary life istuations of the principles of reasoning presented in the chapter. Algebra is kept before the student by means of algebraic applications of geometry and algebra refresher exercises. Many solid geometry concepts are taken up at points where they follow naturally and easily from the analogous plane geometry situations. The following chapter headings give an idea of the content: thinking and the study of geometry, forming a working hypothesis, from syllogism to step-and-reason in proof, analysis and proof, parallel lines, indirect method of proof, a proposition and its converses, inductive reasoning in geometry, necessary and sufficient conditions in proof, related lengths in

figures, proportional line segments in trigonometry and analytic geometry, and measurement of the circle.

Since the method of development used in this textbook may be new to many teachers, the authors have prepared a teacher's manual which can be used as a guide to classroom instruction. The teacher's manual contains a list of assumptions, definitions, and theorems presented in the textbook. The answers to all numerical exercises and to all non-geometric exercises are given in the manual.

This is an excellent textbook, consistent with modern trends in the teaching of geometry. The vocabulary is simple but adequate. The general appearance of the printed page is very good.

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SCHOOL BUILDING SHORTAGE

"Additional floor space equal to a one-story building, 52 feet wide, extending from New York City to San Franscico, Calif., is needed adequately to house the Nation's public elementary and secondary school population," Earl James McGrath, U. S. Commissioner of Education of the Federal Security Agency, said.

Commissioner McGrath made this statement as he revealed results of a Nation-wide survey of school building needs and the States' abilities to provide them. At the request of the U. S. Congress this survey was conducted by the U. S. Office of Education.

"Every parent and citizen should get a graphic picture of the school building shortage," the Commissioner of Education said. For example, this study by the Federal Government and the States indicates a need now for about 708 million additional square feet of school building space for more than $9\frac{1}{4}$ million pupils in public elementary and secondary schools.

"This additional schoolhousing need, which does not provide for increased enrollment next year and succeeding years, and does not take into account future classroom replacements, approximates the total residential housing space in a city the size of Philadelphia, Pa.

"According to this survey," the Commissioner of Education pointed out, "more than 325,000 instruction rooms and related facilities are currently needed this year to relieve overcrowding and to replace obsolete facilities. The estimated cost is 10.7 billion dollars. Since only 5.8 billion dollars could be provided by the States and local school districts under current laws and methods for voting bond issues or raising funds through assessments on property, a deficit of 4.9 billion dollars stands in the way of providing adequate and safe school facilities for every boy and girl in our public schools.

"We know that public elementary and secondary school enrollment will reach new high peaks in the years immediately ahead. The schoolhousing shortage will become more critical year by year. This Nation-wide survey definitely alerts us all to the fact that financing practices will have to be improved and new and substantial resources for public school construction will have to be tapped if deficit dollars are to be raised to cancel out the 'deficit education' created by educationally unsatisfactory and unsafe structures."

Combination TV antenna handles new UHF channels as well as the present VHF ones, except in "far-fringe" areas. Made of aluminum, the antenna combines a UHF and VHF video antenna into a single unit, each element helping the other to give a better video picture. The antenna feeds a single 300-ohm lead-in to the TV set.